TOWARD BETTER SCHOOL DESIGN

WILLIAM W. CAUDILL

An Architectural Record Book

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PREFACE

Architectural styles change. They wear out in time and decay with imitation. The approach to great architecture, however, remains the same and it grows sounder with time and flourishes with imitation. What is this approach? Actually it is a thinking process applied to planning. Can it be applied to planning school buildings? It can. And when we find this approach, our school building problems will unfold naturally into logical, simple, and beautiful solutions. This book is a modest attempt to explain the approach.

The material for this book has been gleaned largely from three sources: (1) research findings of the Texas Engineering Experiment Station, (2) experience of the author as a practitioner, and (3) experience of leading architects and educators whose great contributions made this book possible. The book offers no total solutions or complete plans. These were intentionally left out. Solutions are relatively unimportant because they apply to only a few situations. What is important is a methodology to be applied in each planning situation to make every new school a better school. The readers will note that this book has not been organized into grade grouping classifications such as elementary schools and high schools. But is there really a difference in the approach to planning elementary schools and high schools? The author's experience has been that there is no difference between planning problems on the two levels which is important enough to require a distinction.

As a matter of fact, the approach suggested in these chapters applies to all educational architecture, even to college buildings, despite the Gothic-minded opinions of some college officials. During the past few years, progress in educational architecture has been tremendous at the early grade level, and it is only a question of time until the kind of thinking that has produced so many fine elementary schools and a growing number of equally fine secondary schools will bring some badly needed changes to college architecture. Whether we plan for first-graders or college students, the approach is, and must be, the same.

The most complex school building problem can be broken down into separate and relatively simple and soluble problems. Perhaps this is the key to an understanding of the approach. With this thought, the author uses the case study analysis as a means for explaining the approach to educational architecture.

In order to show how effectively big problems can be broken into little ones, there is at the end of the final chapter a collection of Case Studies. Each of the Case Studies contains: (1) a clear statement of the problem, (2) an account of the approach used to solve the problem, and (3) an explanation of the solution. The problems have been sifted from the more complex, total school building problems. Some cover such broad problems as zoning the main elements of space of the school plant. Others are concerned with such details as planning a simple easel or designing hardware for a classroom door; all are of equal importance because they: (1) suggest the variety of situations in which the recommended approach has been used, (2) offer substantiating evidence for assertions made in the text, and (3) supplement the author's limited experience by calling on experiences of other architects and educators. As planners we might not all agree with every solution offered; in fact we cannot, for the studies offer some conflicting solutions to the same problem. But it is not necessary that we agree; the solutions, however fresh and inspiring some of them might be, are of secondary importance. It is the approach that counts.

The author wishes to acknowledge the great help contributed by the many architects and educators throughout the U.S. who so unselfishly devoted hundreds of hours in preparing a large portion of the material for this book. Their professional attitude for sharing the benefits of their experience with others in behalf of better school buildings for our children give full evidence that the architecture and education professions are ones of the highest integrity. The author also wishes to acknowledge the great help offered by his associates of the Texas Engineering Experiment Station, particularly Bob H. Reed, Ben H. Evans, E. E. Veezey, and Elmer G. Smith. He also wishes to acknowledge the great contribution of his partners, John M. Rowlett, Wallie E. Scott, Jr., and William M. Pena of the firm of Caudill, Rowlett, Scott and Associates. To Dale E. Wretlind and to Cleon C. Bellomy the author wishes particularly to extend a sincere note of thanks for their invaluable assistance in preparing the manuscript and its illustrative material.

CONTENTS

A LISTING OF CASE STUDIES

(Appearing in back of book)

INTRODUCTION

School systems as a public concern have become almost an automatic affair—to many people even a civic chore. Thus revitalization is needed by a good and a new thinking-over of what is at stake. Of course, money is at stake, ample quantities of it, but that is not all, by far. Well-being, health, life, safe survival are at stake.

The fateful thing about systematized schools and schooling is that it stems from the community and again powerfully feeds back into it. The people who build schools will strongly influence the next generation by the kind of schools they build. Stamina, attitudes, abilities are to quite an extent acquired in an early and plastic stage of life in and through the atmosphere we create in schools.

If there is *any* place or occasion where the need for planning and its urgency cannot be doubted, it is in matters of a school system or a schoolhouse. Forethought, anticipation is at the bottom of this whole idea of methodically training the young. If we thought things happened by themselves, we could sit back and serenely watch our youngsters grow up. I am inclined to doubt that home-making can be just an unplanned accretion of incidents, but public education and the provision of its facilities surely cannot.

Of animals even the higher brain-endowed, birds and mammals, still have a simple task in bringing up their next generation for a life that has hardly changed for biological ages, and in a setting that is fairly constant. Compared with this, man is much more troubled with his corresponding task. His endowment, his inventiveness is so vastly remodeling the landscape nearby from generation to generation that training means fitting the heirs to an awful rush of progress and to ever-new crops of it. The communities and the homes change faster and faster, and classrooms as living rooms must remain related to the outer scene, its mental background and repercussions.

William W. Caudill, school planner and research leader, has for years been as dynamic as that outer scene in which schools of today must be planted. The present book reformulates with increased and convincing clarity what must be the fresh, multi-level approach to analysis and solution. Without it we should bewail later how we built our schools; maybe in structures that are strong but fast becoming obsolescent as to layouts or locations.

Mr. Caudill has at the end of his book generously accumulated case studies from the workshops of many professional colleagues, encompassing the more recent evolution of the American school plant down to economical quadruple classroom blocks and widened multi-purpose corridors—which, incidentally, remind me of the Danish and Swedish schoolhouse 'aulas.' But all these case studies are only illustrations to what the author rightly values most: the *approach* to fit solutions to problems which are never quite the same. The thoughts on this main theme he has summed up in seven chapters which should give his gratified reader ample food for thought for every day in the week, so to speak. Especially he makes the last of the seven days a real red letter day when *the planning process that leads to the successful school* is being brightly illuminated.

As, however, a school is for the child, it seems very correct for Mr. Caudill in his disposition of subject matter to begin with the physiology of *the pupil* and to honor his physiological individuality.

Education comes into the child's life as the great socializer. Individualities must unfold and not be impaired, but they must be harmonized as well, teamed and tuned together. Otherwise there is collision, frustration and just that impairment which we dread.

The school plant has an *environment*, and within this is one in itself. The setting here becomes very much a part of the action. The stage is part of the drama of education. The architect will no longer turn it into something of a tragedy.

There is a "biological purchasing power" with which our children are endowed by nature, and they must not be overcharged. Fiscal, monetary *economy* is a grand consideration, but it must not be allowed to govern what is biologically bearable, nor must it blight the educational effort.

City planning places school plants in the body of the community, but school plants in turn grow into nuclei of neighborhoods and are perhaps the greatest instruments to articulate otherwise amorphous growth of the city.

Education fused with instruction is a manifold, many-sided process which plays simultaneously in the numerous rooms and compartments of the school building. *Division of space* is effectively computed in the light of time considerations, and all related arithmetics become to quite an extent *time space* calculations.

Mr. Caudill's book fully lives up to his past renown, to his reputation of placing emphasis not on a formal recipe, on standard layout, but on *approach* to a sound and flexible planning process which will yield as many differentiated results as there are different constellations of circumstances and requirements here and there in the states of this wide country, and all around the planet wherever public education progresses.

Richard J. Neutra

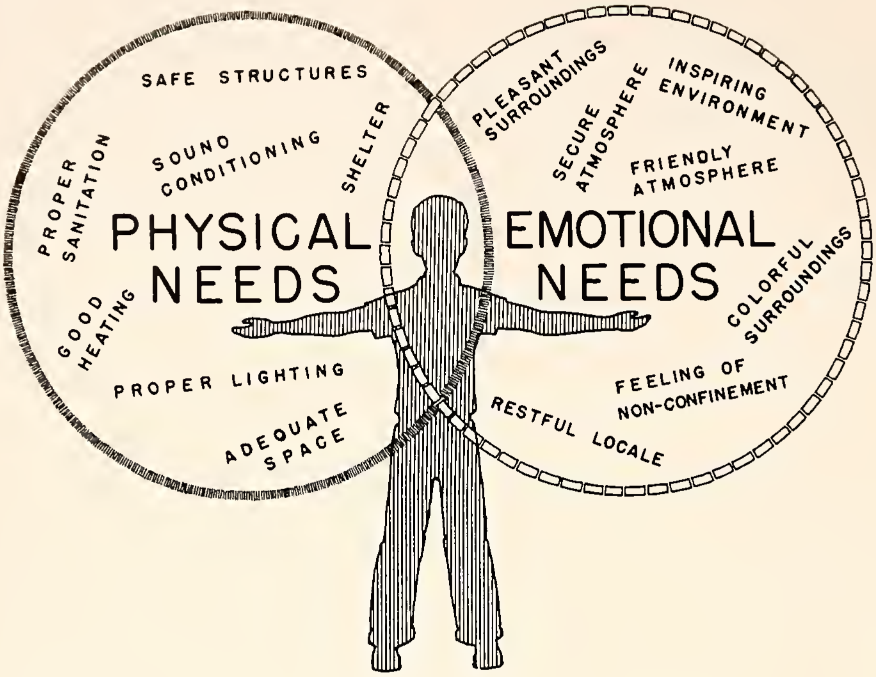
CHAPTER 1 THE PUPIL AND THE SCHOOL PLANT

Speaking on education and the process of learning, Confucius once pointed out that "in offering sacrifices to the water gods, the ancient kings always began with worshipping the gods of the rivers before worshipping the gods of the seas. A distinction was made between the source and the outlet, and to know this distinction is to know how to attend to the essentials."[1] In order to understand educational architecture and the process of planning we must distinguish the source and attend to essentials.

When educators, school boards, architects and others of us meet as school planners, we need the wisdom of the ancient kings, for our responsibility is great and our task is difficult. We feel the importance of what we are doing, and we want to do the best we can. We want a good-looking school. We want a building with a specified number of classrooms and other facilities, a sound structure that will satisfy all building codes and safety requirements. And we want it within the limits of the money we have to spend.

1. If you are a school planner—architect, educator, school board official, or an interested citizen—take a good look at your clients.

1 Superior numerals refer to bibliography at end of book. If quotations are used without referent numerals, it indicates that such quotation was given directly to the author by letter.



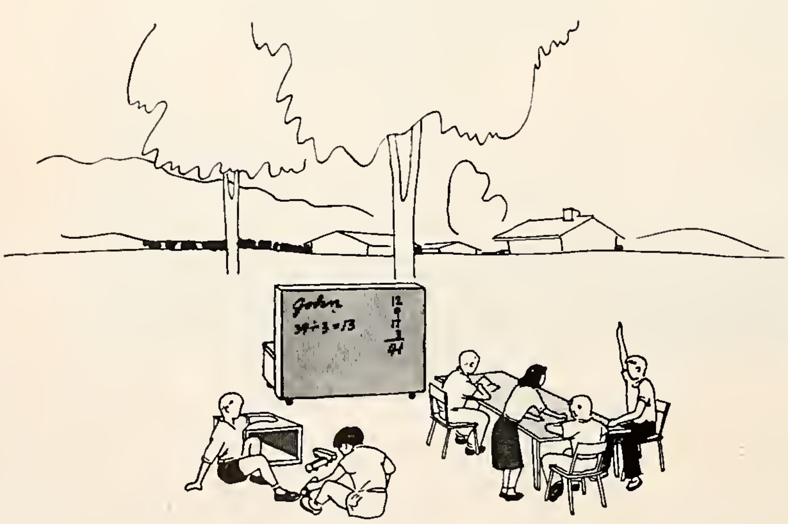
2. School planning starts and ends with the pupil. Every factor must relate in some way or other to the school child. Consider the physical factors: Is the building warm enough for his comfort? Is the illumination adequate? Are there any disturbing noises? Does the school plant have the right kind of equipment? Now consider the psychological factors: Is the building a pleasant place to go to school? Is it colorful and inspiring? Is it restful? Does it make the school children "feel" good to be in the building? We want schools that serve the needs of our youngster—emotional needs as well as physical needs.

But these considerations are all "gods of the seas." The school designed esthetically from the outside in to stir its beholders with its classic, Colonial symmetry, or its pretentious modernity, is a much better monument than it is a school. Those of us who plan such schools worship not necessarily false gods, but the wrong gods first. The school which is designed primarily to surround a certain amount of space and a specified number of facilities with a sturdy, safe shell similarly misplaces its offering. And when we sacrifice the school before the Budget we sometimes sacrifice more than we can afford.

Fortunately, planners today often want more than these. Many of us are keenly aware of the changes this century has seen in the educating process. We know that curricula have become broader and more fluid and that teaching methods have become increasingly varied. We respond to the external pressures of the community. We recognize that a mobile and growing population is causing wide ranges and sharp fluctuations in school enrollment. And we want schools designed to function efficiently in accordance with these conditions.

Function is indeed a river god. Yet although it is near to the source, it is not the source. The school offered to Function as the source is a machine, and like any machine, it is likely to be efficient, but cold and heartless. It might be good engineering; it is surely a little less than good architecture.

Good school architecture never loses sight of the true



3. It is quite possible to hold class out-of-doors in the natural environment during some days, but since we cannot depend on Nature, we enclose the space around the class by use of roofs and walls, and by doing so we create an artificial environment—good or bad—depending on how we do the enclosing.

source, and appeals to Function only in relation to that source. What is the source? Standing behind all the gods and behind every schoolhouse offered to any one of them there is no mistaking the figure of the PUPIL.

Of course, the good school building must be functional. But it functions for the pupil in an environment peculiarly created to help him learn in whatever teacher-pupil or pupil-pupil relationship he finds himself. Far more than mere housing for an academic educational process, no matter how excellent that process is, the good school is a part of the process itself—a primary aid and a constant stimulus to learning—a human instrument. Until we learn this, we will never find the approach to great educational architecture.

The good school is more than a legally constructed shell around a certain amount of space and equipment. It is also a second home for the school child for a good part of his time—an enclosed little world managed by teachers but designed, built, and operated for the child. If it is compromised to meet a restricted budget, it is limited only in ways which do not interfere with the educational and environmental necessities for the pupil.

Considering the pupil as the source, his presence the reason for, and his welfare the primary object of all school planning, we, as planners, must view all our problems in his shadow. Somehow we must produce more versatile and more readily expandable schools, and do it with less money. But above all, we must collectively do it with every idea, every material, every dollar related to the needs of the pupil. This is the way to attend to essentials. This is the way to get good school buildings.

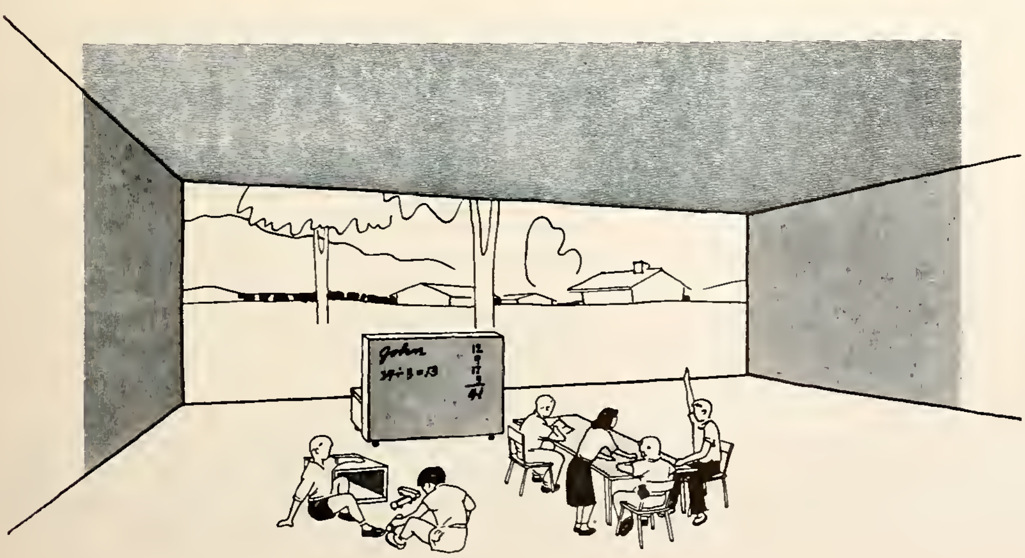
To plan a school that will really take part in the educating process, that will actually help to meet the needs of the pupil, it is necessary first to bring to mind what those needs are. Of course there are educational needs, but these are the concern of the next chapter. There are needs more basic than those. And it is with these elementary needs the discussion of the school planning approach should begin.

CONSIDERATION OF THE PUPIL

Broadly speaking, these basic needs of the school child may be dichotomized into physical needs and emotional needs. The physical needs are those which are taken care of by safe structures, proper sanitation, sound-conditioning, good lighting, adequate heating, proper ventilation, and of course, sufficient sheltered space for him to carry on his work and play. Though there is some overlapping of function, the emotional needs are those administered to by pleasant and non-confining surroundings, inspiring environment, friendly, restful, and secure atmosphere, and colorful spaces. We want schools that serve all of the needs of our youngsters. If our proposed schools do this, we are doing a good job of planning for our children; we are using the pupil as the yardstick with which we measure our work. But to do this we must know the pupil thoroughly.

THE PUPIL AS AN ORGANISM

However coldly detached and elementary it seems, it is helpful to consider the pupil first as a mere biological organism, a body without name or individuality but with life and therefore with needs. The chief advantage of this, provided that we adhere to it, is that it will prevent us from making the usual error of thinking of the pupil as an abstraction or a statistic. This way of thinking is responsible for the inadequacy of thousands of schools throughout the country. If we are to plan schools which will help the pupil, and if we are to consider the pupil as our yardstick, we must think of him always as a living body. When we do we will stop building places to store children and will start building



healthful, comfortable schools designed to be lived in.

Now consider the pupil as an organism. In order to function it needs air and light as well as food. But if the air is too cold or too hot, if it is moving too fast or not fast enough, if it contains too much moisture or not enough, the organism will not function properly. It is the same with light; the organism can have too much, not enough, or the wrong kind. It is also true with sound. Furthermore, the human organism, to some extent, acts upon its environment. It can regulate heat which flows from it; it can regulate the amount of light which it receives; and it can filter sound. So as the thermal, luminous, and sonic environments change, the organism to a certain degree counteracts these changes. For example, on a hot day the skin, which is an efficient heat regulator, can counterbalance the thermal environment by its vasomotor mechanism and by the nervous mechanism of perspiration, and thermal comfort is provided. The eye is a sensitive light regulator. When the luminous environment varies, the eye, like a camera, has a mechanism to take care of this variation which helps to provide seeing comfort. The ear, too, has a certain amount of control over sound. But the human organism has to work within its limits. The function of the skin, the eye, and the ear cannot always provide an equilibrium among the forces of the environment and the counteracting forces of man's systems of cooling, heating, seeing, and hearing. Within a certain range of environmental changes, these systems can operate effectively, but when they are "overloaded," a strain is exerted on the organism. That is why we have to have shelters—to take the load of the natural environment off the pupil so that all of his energies can be free for learning. When the pupil as an organism is out of equilibrium with his natural environment, he cannot work and learn with maximum efficiency. One primary aim of the school planner, therefore, should be to find ways of modifying the forces of the natural environment so that they are within the ranges of the human body regulators. To put it simply, we should design classrooms and other teaching areas in such a way as to provide comfort for the pupil.

The organism acts upon its environments not only individually, but also collectively, and with considerable effect. Take thirty of these human organisms and put them in a classroom. Each one gives off heat, and each one obstructs light as well as sounds. These individual effects add up. A cold classroom which is empty can be made warm by filling it with energetic children. A well lighted, but empty classroom space may be poorly lighted after the children take their places. And, likewise, a classroom acoustically "live" when only a few are present can be "dead" when the room is crowded. These effects must be recognized by architects and engineers who must not allow themselves to forget that the classroom is meant to function with school children in it.

Now with this brief discussion, we can come a little closer to an understanding of how this organism reacts to a typical classroom—the type which is "typical" in the minds of the lay public. Every one knows these classrooms; most adults attended some of them. They are cubes 24 ft. by 30 ft. by 12 ft. with windows on one side and a band of blackboards around the other three sides. Such classrooms give the pupil near the windows too much light, particularly when the sun is shining in, and the pupil across the room not nearly enough. Their blackboards soak up too much light and make a glare of the rest of it. Their walls are painted the dreary, familiar, "schoolhouse brown." They provide practically no ventilation where it will do anybody any good. They give the pupils seated near the heating units too much heat, and those seated on the other side of the room not enough. So far as the educating process is concerned, they do nothing; these classrooms just sit there and by passive resistance force the teaching and learning process into a formalized, monotonous routine. In addition, these classrooms retard the physical development of the pupils. Surely no planners are so diabolic that they would have done this had they thought of the pupils as living bodies!

Planners who begin by thinking of the pupil as an organism are going to realize that his health and his progress are certainly affected by his physical environment, and they are not going to be content to guess about what his physical needs are. They will consider the major elements of the physical environment one by one and then see to it that their new schools actually provide healthful and helpful surroundings. For an example of what can be done in this direction refer to Case Study No. 39, which certainly is a contrast to the so-called typical classroom.

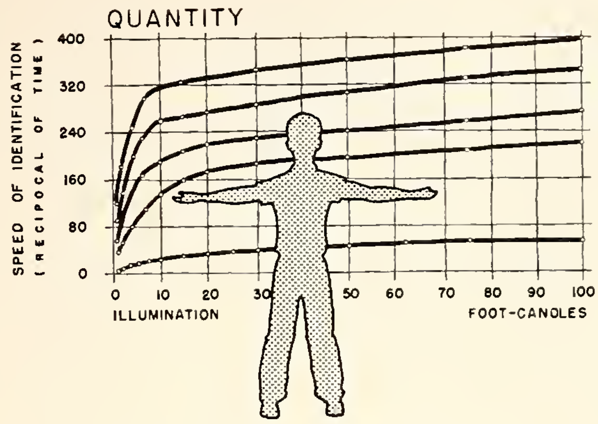
Precisely, then, what is the task before us? It can be explained as simply this: We have a class of children. Each pupil is an organism affected by its environment. Our job is to place these children in an environment which will have the smallest possible adverse effect upon them—which, in short, will give them comfort. It is quite possible to hold the class out-of-doors in the natural environment during some days with each pupil having complete comfort, but since we cannot depend on nature, we enclose the space around the class by use of roofs and walls, and by so doing, we create an artificial environment, good or bad depending on how we do the enclosing. The job we have before us, then, is to find out all we can about what constitutes comfort for children, and then to plan teaching spaces accordingly.

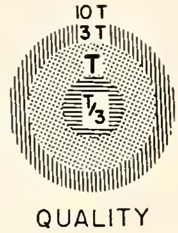
LIGHT AND THE PUPIL

To suggest how much this entails, let us consider the major elements of physical environment as each affects the pupil as an organism. How much light, for instance, is needed for this organism to function efficiently? What

Light and the Pupil

4. How much light is needed *for* the pupil and what kind? That depends, of course, on the task—reading, sewing, games. No one knows exactly, because of variables involved. The pupil himself is a variable. Most authorities, however, agree that the normal-sighted pupil benefits from increasing of intensity up to 200 foot-candles. Just where the greatest benefit tapers off is still a big question. Some research indicates that benefits become progressively less when the intensity is increased above 60 foot-candles. Others show that 10 foot-candles seems to be a more reasonable figure. The chart above is in line with the latter, and has been adapted from a report by Ferree and Rand[11]. The chart shows the effect of interaction of five sizes and varying illumination of test objects upon speed of discrimination. The quality of lighting, according to reliable sources, should be such that the brightness of any surface viewed from the pupil's normal standing or sitting position in the classroom should (1) not exceed 10 times the brightness of the most poorly lighted task (designated as T above) and (2) be not less than one-third the brightness of the most poorly lighted task, with the provision that the brightness of any surface immediately adjacent to the task (T) should not exceed three times the task brightness. With what we know today, these quantity and quality measurements will afford good seeing conditions.





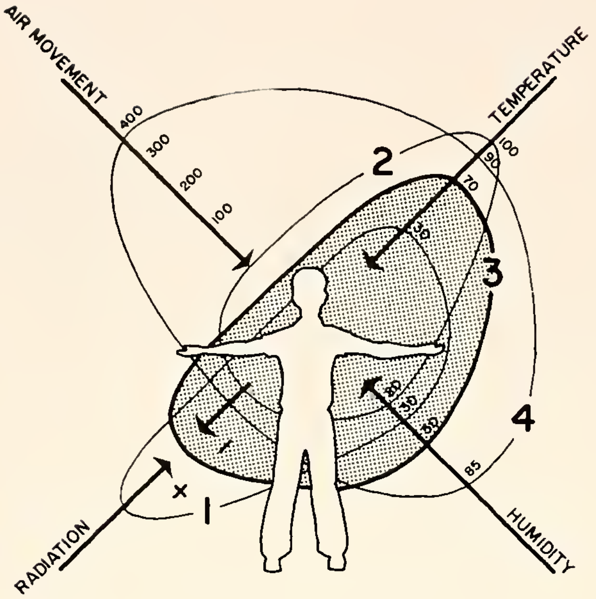
quality of light is required? When we find out these facts we will discover how woefully inadequate the lighting performance of the typical unilaterally lighted classroom is. We will want to bury this old timer. We will insist on classrooms that provide the right amount of light and distribute it evenly without glare all over the room.

How much light is needed? Opinions differ. Some say the pupil can work in comfort with as little as 15 foot-candles of illumination. Others recommend as much as 60 foot-candles. At the time of this writing, the National Council on Schoolhouse Construction recommends a minimum of from 20 to 40 foot-candles and the American Standards Association, with the approval of the Illuminating Engineering Society and the American Institute of Architects, recommends 30 foot-candles minimum for ordinary classrooms. By the time this book goes to press, however, these figures may be slightly higher if the trend continues. During the past fifty years the experts have repeatedly raised the recommended minimum figure. No one really seems to know how much light is needed, although the experts argue about the amount at every conference on school building planning. These arguments always end by the creation of more heat than light on the subject. What is needed is less talk and more down to earth research.

For some reason the English minimums are lower than the American at this time. In England the recommended minimum is 10 foot-candles for ordinary classrooms, and that standard is even prescribed as law by Statutory Order of the Ministry of Education. Research by Hopkinson[4] indicates that although normal-sighted pupils benefit from increases in intensities up to at least 200 foot-candles, these benefits become progressively less when the intensity is increased above 10 foot-candles. With the possible exception of studies by Tinker[5], the research in this country indicates that the 10 foot-candle figure is low. These discrepancies only prove the need for more research. But even with what we know now, most of the classrooms in the U. S. have far too little light.

Perhaps we can comfort ourselves with the thought that quality is more important than quantity. At least this is the general opinion of lighting experts, including Charles D. Gibson and Foster K. Sampson, both of California, who give[6] an excellent account of the quantity versus quality argument. They say that the unit brightness of any surface viewed from any normal standing or sitting position in the classroom should (1) not exceed ten times the brightness of the most poorly lighted task in the room and (2) be not less than one-third the brightness of the most poorly lighted task in the room, with provision that (3) the brightness of any surface immediately adjacent to any task should not exceed three times the task brightness. These recommendations are generally accepted.

Visual comfort in classrooms has to do not only with (1) intensity and (2) brightness, but also with (3) distribution. Of course, the ideal situation is one in which every part of the classroom receives the same amount



Air and the Pupil

5. The sensation of warmth and coldness depends on air temperature, humidity, radiation, and air movement. These four factors of the environment are interrelated and should be considered simultaneously. Under certain climatic conditions, one is more important to the pupil than another. The graph shows how these four thermal forces act upon the pupil. For example, Curve 3, which is shaded, represents what most people think constitutes thermal comfort. In this case comfort is obtained when the air temperature is 70 degrees and the relative humidity is 50 per cent, with comparatively no air movement or radiation effects. Now consider Curve 1. Here the air temperature is approximately 90 degrees and the humidity is also high. Under such conditions, comfort may be provided by considerable air movement, plus any negative radiation effect which might tend to cool the body. Now consider Curve 2, in which the air temperature is still high, but the humidity is low. Comfort in this case is approached when the air movement is cut down. In the Southwest where there are many hot days of low humidity, the wind is not wanted, and in their search for comfort people install window units whose purposes is to moisten the air. Finally consider Curve I. Here the air temperature is low. Neither air movement nor increase in humidity is needed, but in this case a positive radiation effect, such as from a warm panel or the sun, is needed to provide a sensation of warmth. Classrooms, laboratories and other spaces should be designed with these interrelated thermal factors in mind.

of light, but most of the experts agree that an intensity drop across the classroom no greater than 2 to 1 is satisfactory.

Results of performance tests conducted on a variety of classroom shapes are recorded in Chapter Three so that planners might see how nearly these general standards are approached in all of the usual kinds of classrooms.

AIR AND THE PUPIL

How much air does the organism need? Of course the pupil as an organism has to have air to breathe, but usually there is enough in the classroom for all. A number of years ago authorities did not think so, and they passed codes which provided "fresh air to eliminate the poisonous carbon dioxide given off by the pupils." These codes stated that each pupil should receive at least 30 cubic feet of fresh air per pupil per minute. Most of them, however, have been revised to permit recirculating and re-using the indoor air with the addition of only 8 to 10 cubic feet of fresh air, and, since infiltration through closed windows allows nearly that much, fresh air is not much of a problem.

The real problem is largely one of temperature, humidity, radiation, and air movement. This organism must operate within its own body temperature of 98.6 F. or suffer the consequences. Unlike some animals and birds, the human animal must maintain a constant temperature. Of course it has the equipment with which to do it, within limits, but air conditions are often hostile enough to create stresses within the human body. If the air were just right in terms of temperature, humidity, radiation, and movement, there would be no stresses. If all other conditions of light and sound were also favorable, the pupil would be comfortable and his energies would be free for learning pursuits.

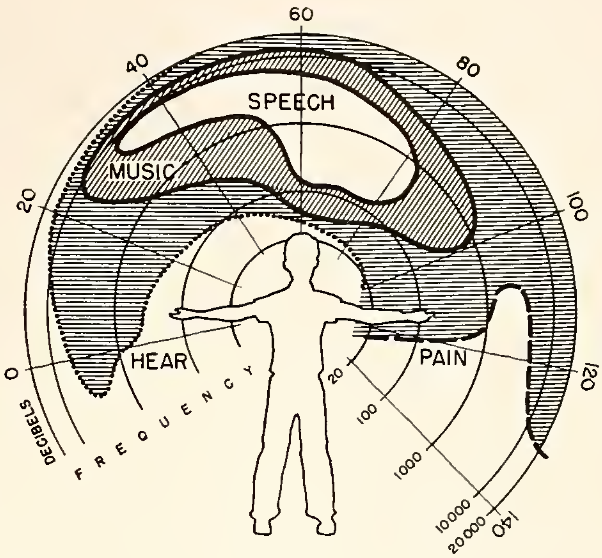
Air temperature, humidity, radiation, and movement are inter-related. Thermal comfort depends on all four. But when we speak of comfort, what conditions are we talking about—a "sitting" situation in a classroom, or an "active" situation? It makes a considerable difference. Much is to be gained by a study of comfort charts such as those published by the American Society of Heating and Ventilating Engineers, but we should remember that comfort varies with our activities. Woodworking requires a different thermal environment than does typing.

There is still much to be learned about what constitutes comfort; in fact we may have reasons to question the information, such as the comfort charts mentioned, which we have at hand. But even now despite this great need for more research, research is still ahead of practice; we are not using the information that we have. Classrooms are being designed in terms of radiators, convectors, and heated floor slabs instead of in terms of the children who have to occupy them. Forgetting the effect that the pupil, as an organism, can have upon the thermal environment, we design most heating systems for empty classrooms. Henry Wright, outstanding consultant on heating and ventilating problems, brings this to our attention when he talks of each pupil as being the equivalent of a 75-watt electric heater[7]. He figures that a classroom full of children, who act like so many little stoves, produces as much as 8,500 Btu's per hour, a quantity of heat which cannot be ignored by the heating engineer. He points out that in the winter months cooling is as much of a problem as heating is.

Certainly in hot school months, cooling is a real problem. Complete air conditioning is getting rather

Sound and the Pupil

6. Not all sound waves are heard. In order to be heard, they must have a certain minimum pressure. The chart above, adapted from one developed by Knudsen and Harris,[12] shows the minimum audible threshold (HEAR) and the threshold of feeling (PAIN) as related to the frequency in cycles per second and the sound-pressure level in decibels. The range of orchestral music (MUSIC) is also shown, as well as the range of conversational speech (SPEECH). As the graph indicates, the sensitivity of hearing varies enormously for sounds of different frequencies, but fortunately the ear can hear the best in the frequency range of speech sound. It is interesting to note that since man developed his speech and music later than his sense of hearing, he adapted them both to the sensitivity characteristics of the ear. But unfortunately today when he builds his buildings he creates some spaces where even the most sensitive ears fail to pick up clear, audible sounds of speech and music. Since good hearing conditions are very important to the mental development of the pupil, it is unfortunate that schools are quite often among those buildings where hearing is very difficult. If we are to free the pupil of nervous strain, we should provide him with acoustically correct school building spaces. We must always remember that good hearing is very essential to good learning.



close to the schools these days. Already in the South, there are a few public schools having air conditioning facilities, and there probably will be more to come, but in the meantime we can help keep our children comfortably cool in most climates with the aid of the wind. The wind, if properly used, may provide comfort through providing a movement of air around the bodies of the children. In situations where both the temperature and humidity are high, air movement, whether caused by the wind or by fans, can help a great deal toward providing comfort. In certain sections of the country where the temperature is high and the humidity is low, comfort is obtained by increasing the humidity through the use of evaporative coolers, a device for increasing humidity. But whether the problem is cooling or heating, it cannot be neglected. If the pupil is too cold or too hot, he works with less efficiency. Since the perception of warmth and coldness depends on air temperature, humidity, radiation, and movement, these four factors of environmental control must be considered simultaneously in the design of classrooms. The importance of each will depend on the local climate, and, accordingly, classrooms throughout the country will have differing emphasis. Here lies the danger of trying to transplant a Boston school to Dallas. The winter clothing for Boston is quite different from winter clothing for Dallas. The pupil wears clothes to help take the load of the natural environment off his body, and his school house is supposed to do exactly the same thing. We should never forget this.

On the other hand, we sometimes have situations where we give the children too much protection and use up scarce building money which could be put to better use. For example, there are many school planners who believe that the expense of heated corridors could be eliminated, and the money put to better use for more equipment and more teaching space. These planners argue that since the pupil is in the hall for such short intervals, particularly in the early grades, these spaces do not require the environmental controls that the classrooms do. They base their arguments on research studies which indicate that sicknesses are caused not by sudden changes in temperature, but rather by prolonged exposure. Case Study 25 is a good example of this sort of thinking. It tells about the planning of a small elementary school in Michigan where the winters are cold, but where the planners could not justify the expense of using heated corridors.

Ironically, the corridors in most of our schools are the most comfortable spaces within the buildings. When we consider the child as an organism which must be in equilibrium with its environment, and when we stop to think where most of the teaching activities take place, we will reverse this emphasis and design classrooms to be as comfortable as corridors: or arrange to teach in the corridors, which might not be a bad idea, as will be pointed out later. In any event, our teaching spaces should be planned with special consideration to the right air temperature, to the desired humidity, to the effects of radiation, and to the movement of the air. These four environmental factors are inter-related and deserve simultaneous consideration. The emphasis of consideration will depend generally on what nature has to say about what the season or day will be.

SOUND AND THE PUPIL

How does sound affect the pupil, an organism? In some ways it affects him just as light does. He can get too much, if it is the wrong kind, and in some cases not enough, if it is what he wants to hear. Disturbing noises

irritate his nervous system and often slow his mental processes. Uncontrolled sound impairs his ability to think and to work. It stands to reason that if a pupil must strain every effort to hear what the teacher has to say, he is missing much energy which he could be using for learning. Bad sound conditions, of course, can put stress also on the teacher (he is an organism, too, you know). He must talk over a constant din all day long. If we can eliminate classrooms which cause words to bounce into mumbles we can help both teacher and pupil, although we might hurt the aspirin business.

According to Richard H. Bolt and Robert B. Newman[8], consultants in acoustics, this is what it takes to hear well: (1) The background noise should be low enough not to interfere with the desired sounds of speech or music. (2) The desired sounds must be loud enough to be heard without effort. (3) The reverberation time must be short enough to avoid echo and long enough to provide some blending. (4) The sounds must be distributed properly throughout the room. Very few teaching situations, not even all of the newer classrooms, can meet these requirements. Recently during the dedication program of a new school in the Southwest, a teacher was asked how she liked her new classroom, which she had been in for about two months. Her reply was something like this: "It is very nice. There is ample storage and everything is new. I am told the lighting is good; so it must be [her way of saying, "but I wonder".] But the classroom gives me a headache every day. Here is why. [She dropped a book.] See what a terrible noise it makes. [Then she crumpled a sheet of paper.] See how the sound is amplified; it starts out a little noise, but it ends up big. Multiply this by ten or twenty and you will have an idea of what I have to put up with each day. I go home with a headache every night. I am under stress and my children must be too. I hope that some day my classroom is treated acoustically like the corridor, which is the quietest place in the school. But we don't use the corridor for teaching."

It is true that we cannot satisfy every whim of every teacher, but this one seemed to have a legitimate complaint. We must provide good hearing conditions in classrooms, auditoriums, and laboratories, or we are not taking care of our school children as we should.

TIME AND THE PUPIL

Since school planners often have failed to recognize the obvious difference in size between children and adults, it is not surprising that they have been quite unaware of a much less obvious, but no less important, environmental factor, the difference in time concept between children and adults. It stands to reason that a year seems longer to a ten-year-old boy than to a man of fifty; the year is one-tenth of the boy's life and only one-fiftieth of the man's. But we do not have to rely on common sense for an understanding of this; Dr. P. Lecomte Du Nouy, the famous French scientist, has proved, in a study[9] concerning the relative rate of cicatrization of wounds and the appreciation of the value of time as a function of age, that a year actually *is* longer for a child than for an adult, both physiologically and psychologically. He concludes that time flows for an adult of fifty about ten times as fast as it does for a child of five, or about four times as fast for an adult of twenty as for a child of five.

What does this mean to us as school planners? It means that the average pupil goes to school about sixteen hours a day. Imagine ourselves sitting in our offices sixteen hours every day! We would become more sensitive to our environment; light, air, and sound would have greater importance; we would be more conscious of color, texture and scale. Any environmental factor which disturbs us now would certainly affect us much more over the longer day. It is important, therefore, to remember that the school which we build for our children is for their use for a much longer day than our own.

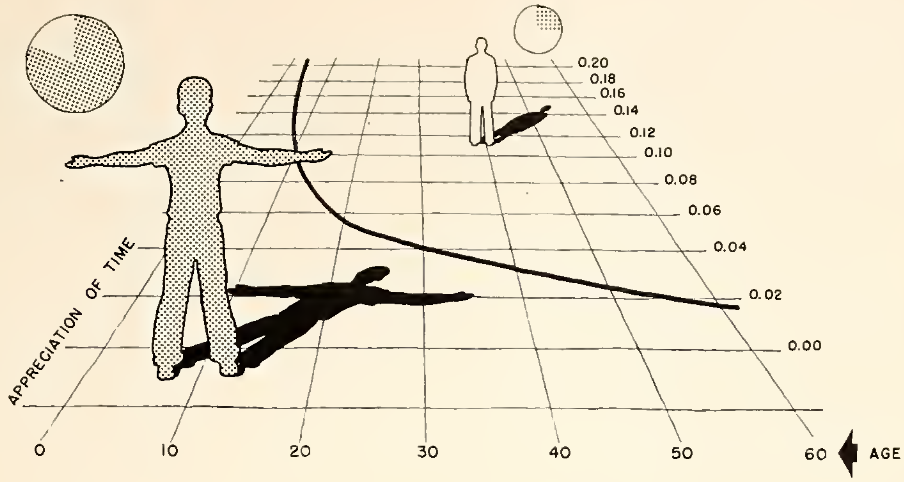
THE PUPIL AS A SOCIAL BEING

If the pupil were merely an organism, the physical comforts as outlined would be enough to help him function at his best. But he is more than that. He is a social being with emotional needs as well as physical needs. Far from being sentimental, any consideration of these needs is plain good sense, for these emotional needs are both real and important.

We, as school planners, often forget this. As school board members, sometimes our judgment is influenced more by tax cutting pressure groups than by the real needs of our children. We become so involved in our fight for economy we start thinking that the schoolhouse is a mere shelter to store the school children, not a place to live, work, and play. As architects, we sometimes get so completely lost in details of construction, we lose sight of the fact that our clients actually are not the school board members or school administrators—our real clients are the children.

If we recognize the child as a social being (and no one is likely to maintain he is not), it is no more than reasonable to consider him as one in our school planning. Because they are social beings, all children, and particularly those of high school age, are going to gather in small groups about as often as they can and where they can. Some of it they will do in their homes, some in their churches, and some in less desirable places. It does not cost very much money to make the school another place to help keep the children out of hangouts and parked cars, but it does require some thought and imagination. Case studies 24 and 26 present economical ways of providing "living rooms" in schools; here are two cases in which the corridors have been planned as living areas.

But merely keeping the pupils off the streets is not



Time and the Pupil

7. The person who said "Time waits for no man" knew what he was talking about, but he could have added, "but it slows down somewhat for children." An hour for the pupil, depending upon his age, is quite different from an hour for his parents. As this illustrates, the appreciation of time for a 10-year-old boy is over three times as great as that of his 40-year-old father. These facts are based on findings of the great French scientist, Lecomte Du Nouy[9]. He has proved that the rate of the flow of time not only *seems* much slower to the child, but psychologically it *is* much slower. The curve above agrees both with the quantitative experiments on the cicatrization of wounds and with the hyperbola determined by simple reasoning that to a man 40 years old, one year represents one-fortieth of his life, while to his son of ten, a year would represent one-tenth of his life, and so on. This means that the pupil spends a great deal more time in the classroom than we realize, and any discomforts caused by light, air, and sound will be amplified by the passing of time. Maybe this is the thing that makes the schoolhouse different from factory or office.

the only reason for making schools livable. The basic aim of education, despite even the materialism of our technical curricula, is to teach the human animal how to live. This education starts in the home, but, like the baton used in a relay race, the aims and practices of social living must be carried from the home into the elementary school, into the high school, into college, and then into democratic adult life. It is too much to expect the home to do the job alone, especially since children spend so much of their time in school. Besides, school, in the eyes of the children, is not so much a preparation for life as it is life itself with very real problems, social as well as scholastic. If we do not take advantage of this in our planning, we are doing only part of our job; if we have not been planning for the social child as well as the physical child and the mental child, we had better broaden our planning concepts.

ATMOSPHERE AND THE PUPIL

Children, particularly those in the primary grades, are still very close to the warm protectiveness of home. They have developed under the love and security offered them by their families, and they are accustomed to the friendly informal atmosphere of the home. They know very little of the world outside this environment, and react strongly toward this world when they do meet it.

They are awed by the echoing vastness inside a cathedral. They are intimidated by the hushed restraint in a library. They are belittled by the looming facades and forbidding, coldly-formed entrances of courthouses, post offices, and monumental school buildings. And they are repressed by the rows of desks bolted to the floor, like cells, five across and seven deep, in the murky brownness of the drab traditional classroom.

They are happier and learn better in schools not so brutally different from the environment they have grown in. They need intimate, cozy schools with welcoming entrances and cheerful, friendly classrooms. And this holds true, perhaps most of all, for those children whose homes are not all they should be. For the need is universal, and the child is bound to respond to its fulfillment.

This applies most obviously to children in the lower grades, but it is important for the older children too: high school sophistication is, after all, a pretty thin veneer. In some ways the emotional needs of the older children are greater; they can become more lonesome for companionship, and their social problems can become more exaggerated. Life for a teen-ager is both complex and turbulent. The older child does not have exactly the same emotional needs that the younger child has, but he does need a cheerful, clean, and wholesome atmosphere in the school just as much as he needs it at home. And there is not much excuse for our not giving it to him when we plan his new school.

SCALE AND THE PUPIL

Although the word "scale" is used by every architect when he speaks in terms of architectural composition, it is very difficult to define. Scale is a sort of imaginary yardstick which the architects use to bring all of the architectural elements, as well as the details, into harmonious relationship with human beings. In one way scale relates to the dimensions of the human body, but in another way it relates to the mind. A room large

enough for a physical function may sometimes "feel" too small. If so, then it is too small because it is out of scale with human feelings. It is difficult, for instance, to carry on an intimate conversation in the middle of an over-sized room.

The importance of the consideration of scale applies to all building types. For example, people who have a yen for Colonial architecture often plan small houses with approximately the proportions of the wonderful, but huge Southern Colonial mansions. When these same people move into their "Colonial" homes they are terribly disappointed, because they have a miniature instead of the real thing. The dollhouse copies of the magnificent Colonial mansions are simply out of scale.

Scale is important in school buildings, too, but there it presents a unique situation, particularly in the early grades. Not all of us can agree on just how the pupil is affected by scale. Some say that ceiling heights, for example, are of no importance in determining how the classroom feels to the child. The author, however, cannot agree; it seems apparent that ceilings can help to produce either an intimate or an awing atmosphere for children, especially for small children. Architects and school people will probably always argue among themselves on this point. But when the discussion gets to a consideration of the anatomy of the pupil, then there is not so much a variance of opinions. Everyone agrees that the pupil should not have to tip-toe to reach the chalkboard or have to sit in a seat too large or too small for him. But we still have schools, elementary schools at that, which are scaled to the adult. The child who uses them lives in a world constructed for adults. Doors he cannot easily open, stairs hard to climb, windows too high, coat hooks, drinking fountains, and shelves too high, and furniture too big—these serve to remind him constantly that he is small and dependent in a world of watchful giants. He will move with more ease and more peace of mind when the spaces of the school, the equipment and furniture are all scaled to his size. He will feel that this place was created for him, and he will be more self-reliant and do more and better work.

COLOR AND TEXTURE

It is not hard to imagine what the feeling of the school child must be when he is seated in the middle of a brand new, perfectly lighted, but cold and unfriendly classroom. He probably feels as if he were seated in the bottom of a high piece of crockery. The walls that surround him have no warm color or soft texture; they are made of hard plaster, painted all the same white-washed color. Such a colorless and textureless atmosphere should not be found in schools.

Children are accustomed to color; they like color. And, being more impressionable than adults, they respond to color psychology even more readily than their elders.

Those industries catering to children have given them plenty of clear, primary colors in their toys, their clothes, their books, and more recently in color cartoons. And they have found this good business or they would not continue to do it. Everyone knows a small child will play with a bright red and yellow toy in preference to a drab toy of the same kind. And everyone who has taken a child to the theater knows he invariably pays closer attention to cartoons and features in color than to those in black and white.

The effect of color on the psychological processes of humans has long been established. Practically all adults know, for example, that greens, aquamarines, and blues tend to be easy on the spirit and the eyes and that harsh bright colors are stimulating and sometimes distracting. Adults use colors widely and generally well, for themselves, in machine shops, assembly rooms, automobiles, theaters, department stores, cocktail lounges, and homes.

Adults would not tolerate for an instant a home kitchen or an office reception room done in drab tans, dull grays, or shabby gray-whites. Yet these are precisely the colors they usually inflict upon their own children in the schools. If color is worth something to adults, it is no less valuable to pupils. If color can help the pupil to like his school and to learn better in it, there is no valid reason it should not be used for that purpose. Certainly the economy argument cannot be used. A bucket of paint costs the same regardless of color.

Texture usually does not cost any more money either. Creative architects have been bringing inexpensive outside materials to the inside of the buildings with considerable success in producing colorful and highly textured spaces. Brick and natural siding with their own built-in colors have been particularly successful. More about this will be found later in Chapter 4.

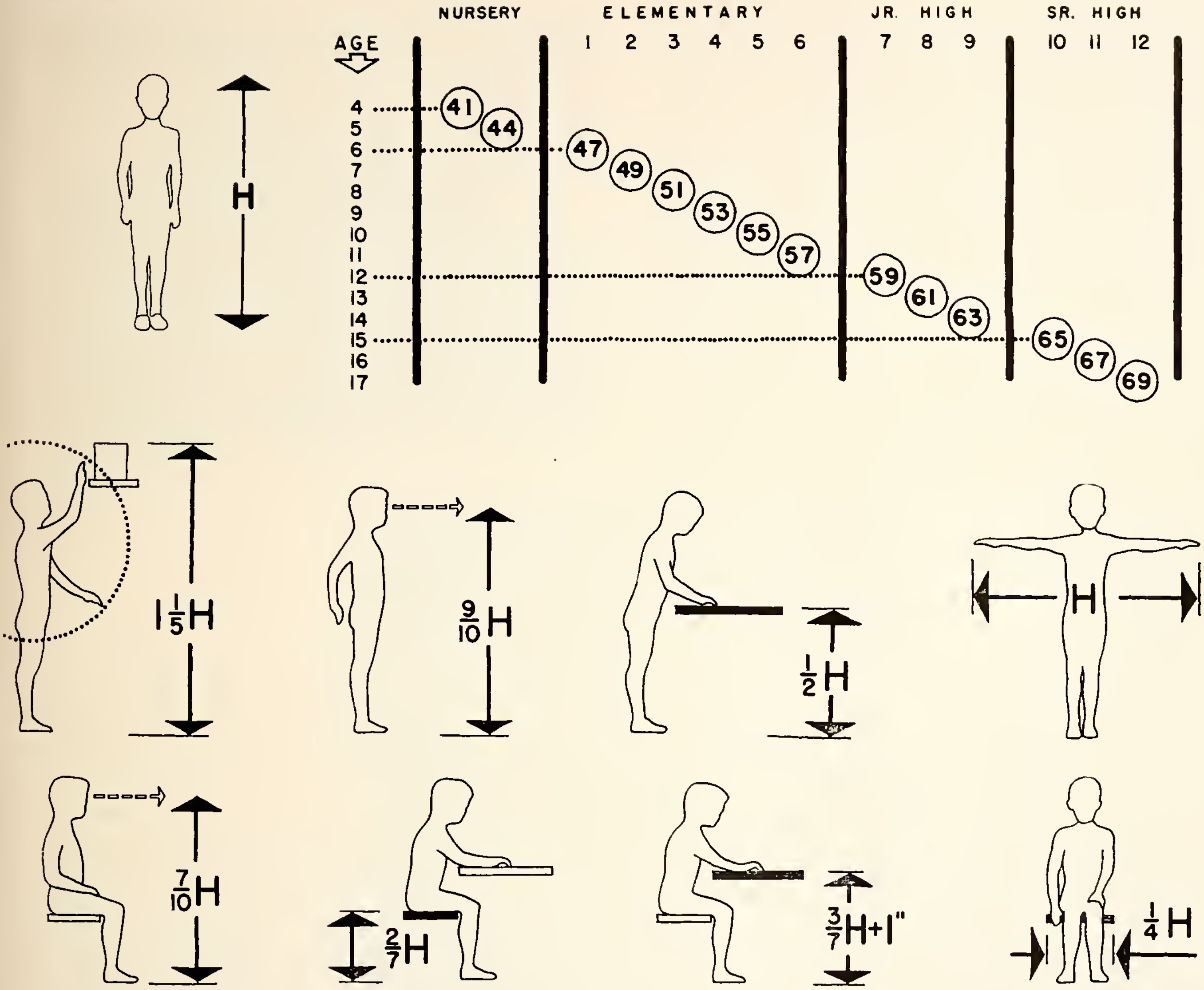
Pupils of all ages are sensitive to color and texture. The design of walls, floors, and ceilings should show consideration for the pupil's emotional needs as well as for all his other needs.

COMFORT AND SECURITY

This is a part of what it means to plan schools for the pupil—to consider his physical and mental welfare as a primary reason for and object of school planning. The remainder of this book attempts to develop the concept more completely and in more practical detail. The central thesis is that schools are for school children. The good school building is one which is designed and equipped to make the pupil comfortable in all that he does, to give him a sense of security, and to help him in every way it can to learn in the pupil-pupil as well as the teacher-pupil relationship by which the chief work of the school is carried on.

This, of course, is not the only point of view from which school buildings are planned, and because there are others, this one has been given a label. Advocates of some other points of view have called it, and not always flatteringly, "the comfort approach." There is nothing wrong with the label so long as it is understood that the

The Physical Size of the Client



8. Schools are built for the pupil. If shelves are too high to reach, seats too small to sit in with comfort, or spaces too small for individuals or groups of pupils to work in, then the school cannot function properly. These are some characteristics of the anatomy of the pupil, based on statistics prepared by the U. S. Department of Agriculture. The pupil is the yardstick, a varying measurement from one age group to another. These diagrams are based on "H", the average height in inches indicated in circles for each age or corresponding grade.

comfort is not merely for comfort's own sake, and that comfort relates to the mind as well as the body. More accurately it might be called "the humanistic approach," or "pupil approach," if such terms can be applied in their simple, non-neoclassical sense. Whatever its label, since this comfort approach is only one of several, it is necessary that it be explained and its parentage revealed.

ORIGIN OF THE HUMANISTIC APPROACH

The humanistic approach has developed gradually over three hundred years of American history. A quick look at the history of American architecture as a whole will help us to appreciate the background of this approach and its ultimate influence on the design of school buildings. For a thorough discussion of the subject the reader is referred to James Marston Fitch's excellent book[10] AMERICAN BUILDING, from which much of the following material has been drawn.

The disparity between style and function, between the desire to impress and the need to create practical shelter, has existed since Colonial days. While Renaissance, Georgian, and Classic Revival buildings were being erected in the Colonial capitals, the common people were working out their own practical theories of building, using the materials they found at hand. Jefferson was probably the first to understand these trends. He acknowledged the political importance of style in the public buildings of a young nation, but in his school and

university buildings he gave first consideration to function. In fact, his architectural concept for a statewide system of education marks him the true father of the "comfort approach" to school planning:

> I consider the common plan followed in this country—but not in others—of making one large and expensive building as unfortunately erroneous. It is infinitely better to erect a small and separate lodge for each separate professorship, with only a hall below for his class and two chambers above for himself; joining these lodges to barracks for a certain portion of the students by a covered (passage) way to give a dry communication between all the schools. The whole of these, arranged around an open square of trees and grass, would make it what it should be in fact—an academical village . . . (Such a plan) would afford that quiet retirement so friendly to study, and lessen the danger of fire, infection, and tumult.*

But important as Jefferson's functional school buildings appear today, they were little noted at the time, and with the rapid growth of the factory system the breach between style and function was dramatically widened. By the middle of the Nineteenth Century it became evident that industry could not tolerate the old formal limitations, and must evolve practical buildings to do practical work. In the course of developing its new buildings, industry bypassed the architect and turned to a new professional man, the engineer, who compensated for what he lacked in esthetic appreciation with an ability to build quickly, cheaply, and efficiently. Yet he created beauty in spite of himself, and although he did not articulate the concept, he began to sense that form must spring not from preconceived notions of style, but from function efficiently realized within the limitations of material and process. Meanwhile the architects drifted farther and farther from the main course of American building. They became school-trained and society-joining professionals, preoccupied with abstract "beauty." Convinced by Ruskin and Greenough of the inadequacies of classic design, they embarked on a spree of romantic reaction, fiddling confusedly with "the Gothic, the Egyptian, the Romanesque, the Byzantine, the contemporary French" and covering them all with jigsaw gingerbread.

So the gap between style and function became also the gap between architect and engineer. It was widest in the Northeast, where the later Nineteenth Century industrialists inconsistently demanded technical efficiency from the engineers and conservative imperial symbolism from the architects. In the Midwest, however, different social, political, and physical conditions—including the Great Chicago Fire of 1871—provided a fertile field for the development of a progressive and meaningful architecture. The result was the famous "Chicago School" of Richardson, Wright, Sullivan, and many others only slightly less great.

These men embraced the opportunities and challenge of America's industrial progress, and made architecture again a living part of American culture. They produced buildings designed from the inside to house efficiently whatever they were supposed to house, and to look like what they were. To varying degrees they made use of the vast improvements in equipment, materials, and processes which were the products of industrial building. Although Sullivan did not invent the multi-storied building or the steel frame, his Wainright Building, built in St. Louis in 1891, became a prototype which was not much improved upon either in plan or elevation until the Second World War, and it is Frank Lloyd Wright who has managed over six decades to develop the Chicago principles and to win their acceptance as the highest standards of American architecture.

Wright's long and amazingly fruitful career provides a thread of continuity between the promising days of the Chicago School and the present. For the immediate influence of Richardson, Sullivan and Wright was limited, and the intervening period (roughly 1910 to 1933) showed reaction rather than progress in American building design.

This was a period of rationalization in building technology, of gestation, of great quantitative advance in building. America built prodigiously, and it built along well-established lines. The result was a remarkable improvement in the technological level of the entire building field and an equally remarkable stretching of hopelessly archaic formulas. "No building was too tall for a classical colonnade, no gymnasium too bulky for 'Collegiate Gothic,' no house too small for false Elizabethan timberwork."[10]

Though architecture had stalled, except for the work of Wright and a very few others, that period saw important advances in city planning, parks, and housing. And this led to another element of the comfort or humanistic approach—the realization that the spatial relationships inside a building are also closely related to external relationships between buildings and between buildings and grounds.

The progressive architects did manage to make significant gains during this period. They traded with others like them in Holland, Germany, and Scandinavia. In the 1933 Century of Progress Exposition in Chicago, they gave the layman his first good look at living architecture in this country. And the battle they had already won in commercial and industrial buildings they carried to upper-class residential work, public buildings, and churches. They fought the Tories who extolled the Rockefeller restoration of Colonial Williamsburg to a standstill, for they had all the facts, and eventually

* The above is a letter to the Trustees of East Tennessee College, May 6, 1810, quoted by Fitch in AMERICAN BUILDING[10] on page 33. It appears that Jefferson's scheme would be the granddaddy of the "decentralized school plant" with its connecting covered corridors. For another "academical village" give note to Colbert's "School Village" in Chapter 5 of this book.

1915

The Old and the New: Prestige vs. the Pupil

9. The left photograph is of an old school planned about 1915. The photograph below shows its successor, planned some 35 years later. Both have common sites, climate, and number of students; yet the contrast between these schools is distinct. There are many reasons for this contrast, including developments of structural techniques and planning methods, but the greatest of all is that the old school was primarily designed to impress the adult and the new school primarily designed to impress and provide comfort to the pupil.

1950

most of the propaganda, on their side.

Since that time American building has continued in a state of crisis involving every phase of the field. There still are Tories who cannot face the struggle to meet the needs of their society and who continue to turn stubbornly to the past for solace. There are builders who are all science and will not or cannot recognize the importance of esthetics. There are designers who emphasize function, structure, plan, or esthetics at some cost to the others and are content with that because their own development is out of balance. There are eclectics who fancy they see in what they call "the modern style" a characteristic set of symbols which they can employ to make their buildings look like something they cannot be. There are also planners who want to understand the necessary fusion of function, form, and beauty, and who, under whatever personal limitations they are burdened with, work sincerely toward this goal.

This latter group includes those who follow the "humanistic approach." They do not claim to be infallible, but they know that their efforts are at least in the main stream of democratic American architecture with roots in the earliest practical building of the American people. They know that their progenitors have never been reactionary, unrealistically romantic, or eclectically hostile to industrial progress or to the real needs of their clients. They are professional men who try to make full use of the materials and processes industry can offer them in planning buildings, schools included, which will fully meet the needs of their users,

Development of Schoolhouses in the United States

10 1800

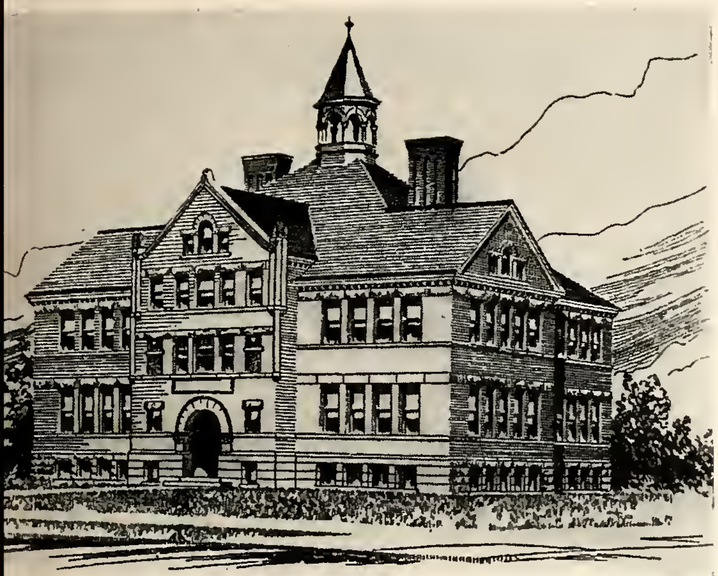
13 1895

14 1900

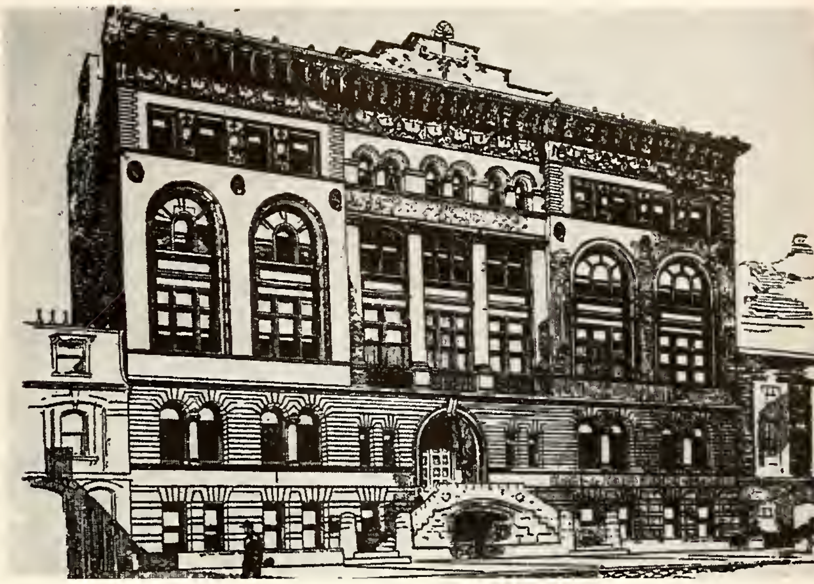
17 1930

18 1949

11 1850



12 1870



15 1910

16 1915

19 1952

will perform their functions efficiently, and will be beautiful in the way they must be. And they are not so naive as to believe that so complex a task can be done by guesswork and a couple of handbooks on heating and plumbing. They need the methods and products of science and are grateful for its help.

SCHOOL ARCHITECTURE AND THE CHICAGO SCHOOL

The Chicago School did much for school architecture through such men as Dwight H. Perkins and his contemporaries William B. Ittner and John J. Donovan. These men and their colleagues brought common sense and creativeness to school buildings. Some of their schools constructed right after the turn of the century are prototypes for some of today's outstanding school buildings. We talk about bilateral lighting, or even trilateral lighting, as being latest developments. But these men were using such techniques forty years ago. We talk about achieving economy through "honest expression of the structure." These men did the same thing, for some of their schools have exposed columns and beams as well as ceilings that double as roof decks.

Any account of the architectural development of school buildings in the United States certainly would not be complete without a statement concerning the writings of Donovan of California. His book *School Architecture—Principles and Practices*, was the "bible" for years. C. B. J. Snyder of New York City should be included in any history of educational architecture. Snyder, who came before the Big Three mentioned above, was going strong at the turn of the century.

We have noted that American architecture in general drifted backward after the first advances of the Chicago School, and failed to get under way again until 1933, but in school architecture the retrogression lasted even longer. It is rather hard to explain why architects and school people would let the spirit of progressive planning be stifled. But there is no doubt about it—from 1915 to 1945 progress in school planning slowed up, and probably the greatest reason was the enactment of codes and regulations. Laws were passed that restricted bilateral lighting. Laws were passed, too, that regulated the size and shape of classrooms. There were even laws that said in just what direction the axis of the classrooms should be oriented (generally west and east). Only a good Mohammedan could catch the spirit of such planning. These laws were passed in good faith, but bad judgment.

Today, we have begun to make use of the creative approach which was given to us by the Chicago School, but which we rejected. Now creative architects throughout the entire nation are working together to forward the cause of school architecture. The American Institute of Architects has joined in the cause through its permanent Committee on School Buildings. The educators, too, have joined hands with the architects to help produce better schools. The National Council on Schoolhouse Construction particularly made a great contribution, along with American Association of School Administrators. Education and architecture are at last united in the effort to provide the best possible learning environment for the pupil. This historical sketch stemmed from a discussion of the needs of the pupil. It provides the background for what is now happening in school architecture.

1950—A TURNING POINT IN SCHOOL ARCHITECTURE

Historians might say that 1950 brought a new light to educational architecture—a new movement based on the needs of the pupil. Whether or not 1950 goes down in the history books as a turning point toward improvement of school buildings, it can certainly be said that 1950 represents a year in history when for the first time a large majority of architects and educators throughout the entire nation got together to try to solve their common problems. Many conferences were held where the average architect and the average educator participated; consequently the average school building began to approach the quality of more advanced prototypes. Cities began to revise their codes. The professional journals began to be more discreet in their choice of schools for publication. By 1950, the battle between "contemporary" and "traditional" was won. The public not only began to accept "modern," but demanded it. So the architects had no choice but to try to produce logical schools. And they began to do it. This new movement unquestionably grew out of the Chicago School of Architects, but it brought along educators as well as architects, and together they are forwarding the cause of architecture for children.

There are many architects who are leading the way in this new movement but outstanding among them are Richard Neutra, Henry L. Wright, Ernest Kump, John Lyon Reid of the West Coast region; Lawrence Perkins (son of Dwight H. Perkins associated with the Chicago School), Phil Will, Eero Saarinen (another famous son of another famous architect), and Eberle Smith of the Great Lakes region; Douglas Haskell, Lawrence Anderson, Alonzo Harriman, Walter Gropius, Walter Bogner, Stanley Sharp, Henry Blatner, Jay Van Nuys of the Northeast region; and Don Barthelme, Charles R. Colbert, John M. Rowlett, Wallie E. Scott, Jr., O' Neil Ford, Charles Granger of the Southern region. These architects are a few among many who are going about planning schools giving emphasis to the needs of the pupils. Educational leaders who are helping in this movement, to name only a few, are Walter Cocking, N. L. Engelhardt, Archibald B. Shaw, Henry H. Linn, Ray Hamon, John Marshall, Ralph D. McLeary of the East Coast; John Herrick, Dan H. Cooper, Paul Seagers,

Wilfred Clapp of the Middlewest; and Charles Bursch, Charles Gibson, J. D. MacConnell and Harold Silverthorn of the West Coast. Again these are a few among many, but their names deserve more than mentioning in any history of educational architecture. Through the leadership of these outstanding architects and educators the present situation of school planning looks good. The future looks even better, because within the new crop of young architects and educators there are many who have caught the pupil theme idea with aims to perfect it. Today architects and educators everywhere are beginning to see the value of working together, jointly, to plan schools based on the needs of the pupil. Finally we are beginning to break the bonds of preconceived spaces and shapes. At last we are getting rid of our outmoded codes, and we are alert to the dangers of passing new ones which might some day in the future restrict our chances of developing better school buildings. Realizing that school architecture, like democracy, develops through stimulation, not dictation, we are beginning to see that even the best examples of school buildings are only steps towards perfecting better ones. Yes, we are on our way to better things for our pupils, because we have recaptured the approach to architecture, the approach based on human needs—physical, spiritual, and mental.

SCHOOL ARCHITECTURE—THE PUPIL APPROACH

The "humanistic approach" or in the case of school buildings, the "pupil approach," insists that school planners should begin with a clear and scientifically accurate realization of the actual physical and emotional needs of the pupil, and should never in any phase of planning compromise in meeting those needs. This is the intended meaning of "humanistic." But this approach insists also that these needs are to be met for the purpose of helping the pupil to perform at peak efficiency in a school designed to function as a positive and flexible aid in the educational process as the best contemporary thought conceives that process. The school is a building for learning; comfort is the bride of function.

This approach recognizes that a school must also be strong, safe, and economical. And it is not too proud to call upon science, technology, and industry to furnish the materials and methods to help make it so at no cost to the pupil's welfare.

It holds too that logically "form follows function" and, beyond that, that form should express function. It sees virtue in a school which says honestly and clearly in every line, "I am a school; I am here to do a job, and I am not ashamed to show you what I am and what I am doing, for I am doing it well." On the other hand, this approach sees a positive evil in schools which pretend to be colonial mansions or wear ornamental costumes, archaic or modern. These schools do not do their work as they should and thus have a reason to hide what work they do, but they can have no reason for making the children pay for their fancy-dress in physical and emotional discomfort. Even though the individual payments are small, which they usually are not, they are paid on an installment plan which lasts the entire life of the school.

Even the appeal to beauty cannot excuse this masquerade. Those who hold eclectically that architectural beauty is applied as style from the outside like icing on a cake—or worse, that architectural beauty is the basic concept to which every other consideration bows, have been dead since before the Civil War and have done nothing but contaminate American architecture since that time. Schools should be beautiful, of course, but a concept of beauty which conflicts with both function and logical expressive form is a dishonest beauty.

The "pupil approach" is no less conscious of the esthetic than is any other approach, for it is keenly aware of the importance of beauty to the pupil as well as to the passerby. And it is fully aware of the ideological import of architectural esthetics. It stands firm in the belief that the beauty which comes from good composition of the most suitable building materials used honestly and openly to express the function of the school designed for children is at once the kind of beauty that will make that school a better school and the kind of beauty which best expresses the ideology of the American people. The American people have no more need for borrowed Greek associations or for nostalgic sentimental longings for the past. They have come of age with their own ideology of equalitarian democracy and their own culture based on science, technology, and industry. This kind of architecture is an honest expression of that culture at its best.

Finally, this approach insists that there is no "modern style" as such. Each new building ideally is the product of specific solutions to individual problems peculiar to that building's particular environs, site, function, budget, and designer. If two new schools are similar in appearance, they are, or should be so, only because they were designed to perform similar specific functions in similar environments under similar sets of circumstances. The point is emphasized because a new generation of eclectics has spawned. These draftsmen, like their progenitors, do not and cannot face the real needs of their client, in this case the pupil. They do not understand the necessity for planning for the needs of school children through function to appearance, but they know that to survive they must conceal this failing. Consequently, they skulk about and steal outward effects from examples of functional, living architecture, and these effects they crystallize as symbols and apply like icing to the exteriors of their necessarily inferior buildings. These men are not architects, no matter what their licenses say; they are architectural pickpockets.

The Importance of Beauty

20. Beauty which comes from good composition of the most suitable building materials, used honestly and openly to express the function of the school designed for children, is at once the kind of beauty that will make the school a better school and the kind of beauty which expresses the ideology of the American people.

The quality of their products gives a bad name to all new architecture, for the layman, judging largely by appearance, cannot readily distinguish between the real and the fraudulent.

The layman can, however, detect and thereby protect himself from these con men. Almost all of them think of themselves as "moderns"; that is, they see themselves as members of a modern school—devotees of a cult worshipping a collection of effects. They use certain materials, adopt certain forms, decorate with certain appurtenances because these things are "modern," and, fortunately, they say so. They cannot explain their effects coherently on more pertinent grounds. Educators and school board members have only to hear a competing architect justify a glass wall or an overhang, or anything else, on the grounds that it is "modern" to know that in hiring him they would become accessories before the fact.

A TRINITY OF SCHOOL PLANNING

In order to keep in mind the basic elements of this admittedly and necessarily complex humanistic or pupil approach, it is helpful to conceive of the good school plant as based on three planning factors so inextricably fused that they form a kind of trinity, a three-in-one consideration dedicated to make the school the most effective possible for the school child in the teacher-pupil relationship of school life. The three are environment, education, and economy. The structure must (1) facilitate to the greatest possible degree the educational methods and the curricula by which that process is controlled, (2) provide an environment of maximum desirability for pupils and teachers engaged in the learning process, and (3) achieve both these ends harmoniously within the limitations of the community budget.

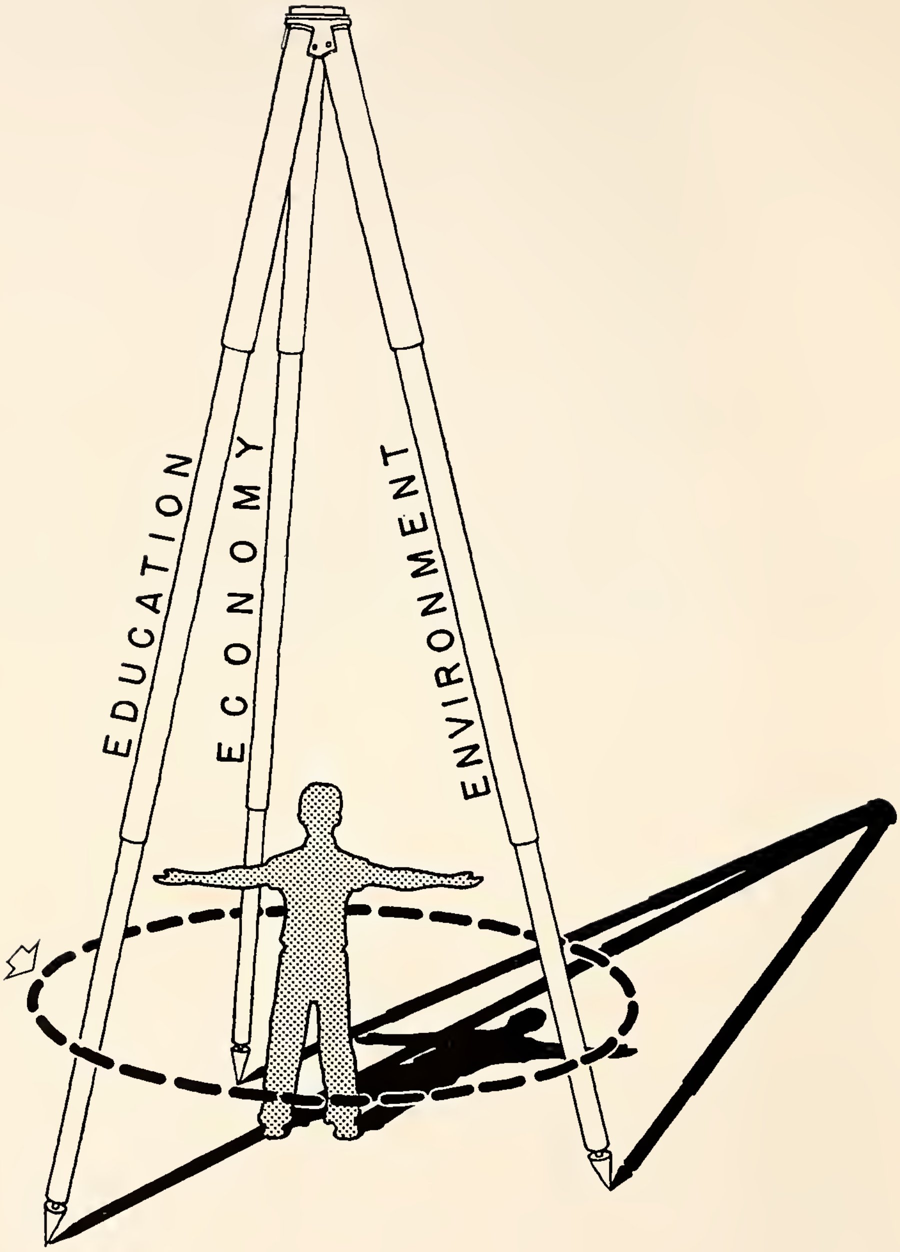
One of the best ways to grasp the trinity concept is to think of each of these three planning factors as an adjustable leg of a tripod* which must be set within the confining limits of the pupils' needs. A good school building is one that acheives a sort of a trilateral balance among these three factors without a neglect of the basic needs of the pupil. To illustrate, let us assume a typical school building situation. A community wants to build a school: it needs so much space; it wants that space to be safe, healthy, and stimulating; and it has so much money to do this. The first thing that the planners do is to list what space and equipment are needed. The final listing of these needs determines the length of the first leg of the tripod—the educational leg. Then the next thing they do is to make a list of the environmental objectives, such as the kind of heating that the children need, the amount and quality of lighting, the building materials required to give the right kind of atmosphere, and so on, all of which determines the length of the second leg of the tripod—the environmental leg. Then the planners determine the length of the third leg, the cost leg, by finding out how much money the community can or wants to pay for all of this. When all three legs have been adjusted to meet the needs of the pocket-

* The author credits superintendent Dr. Wm. E. Moreland of Houston, Texas for the tripod analogy.

book, invariably the third leg is too small. Always the community wants more than it can afford, or, as the saying goes, it has "champagne taste and beer pocketbook." So in order to achieve the trilateral balance needed to steady the tripod, either the first two legs must be shortened by trimming down some of the desired items or the third leg must be lengthened. Whatever the solution, a good school building program must be founded on a balance of these three great factors,—education, environment, and economy. The next three chapters will give special emphasis to each of these factors, but it should be remembered that because of their interrelationship we cannot think about one without thinking the other two. It should also be pointed out before we leave Chapter 1, that although we may become lost in everything from teaching methods to foot-candles, the only reason we are discussing these things is to give our little guy or gal a better school building.

CASE STUDIES WHICH ARE RELATED TO CHAPTER I

No.	*Problem*
24.	Can corridors be made to serve purposes other than walking space?
25.	Can open type corridors be used successfully in the northern-most area?
26.	Can corridor space be used for purposes other than circulation?
39.	How effectively can artificial and natural lighting be integrated?



21. The successful school plant is one which achieves a tri-lateral balance among the forces of the three great factors—education, environment and economy—all of which relate to the basic needs of the pupil. For a clear conception of this tri-lateral balance, imagine each of the three planning factors as an adjustable leg of a tripod.

CHAPTER 2 EDUCATION AND THE SCHOOL PLANT

22. The first step in school planning is usually to list the educational needs. This listing determines the length of the educational leg of the tripod.

In one sense, space is the common denominator between architecture and education. Education requires certain kinds of spaces and equipment to carry out its function; architecture involves the ways and effects of arranging and enclosing these spaces. Therefore, if the aims of education are to be facilitated by the school plant, planners must know these aims and have some idea as to the kind of spaces and equipment needed to carry them out. It is the purpose of this chapter to distinguish the aims of education of today's elementary and secondary schools from those of yesterday's schools, to translate these aims into sympathetic architecture, and to suggest an approach common to the design of both elementary and secondary school buildings.

THE STUDY OF THE PROCESS

When asked how he would go about planning a school, Richard Neutra, one of the world's great architects, said with a smile that his approach would be the same as if he had been given the assignment to plan a canning factory. These are not his exact words, but in essence this is his explanation: "If I were given the task of designing a school building, the first thing I would do would be to find out what would take place within the building. In many respects the approach is no different from that required in planning say, a cannery. I would passionately study the process of, let us say in this case, canning tomatoes. I would look into how these tender tomatoes are first grown, then picked and brought in from the fields; how they are cared for, cleaned, and cooked, how they are graded and assembled into containers, how cans are sealed and labeled, and how the containers must in turn be fitted together in manageable boxes for economy in handling. I would study the space involved and the equipment necessary to carry out this process of preserving and developing God-given qualities and nature's endowment, and all our treating and trafficking that goes with it. In the case of the school I would do rather the same thing. I would study the process, in this case the process of

education. I would find out the spaces required and the equipment necessary to carry out the process effectively in terms of the child and efficiently in terms of the teachers. Then I would mold my architecture around this process. Only the qualifying word of warning: This process of education concerns *living*, growing young humans, about the most sensitive, precious goods on the planet, and we are readying and preparing them for shipment into our communities of tomorrow." With these comments Neutra has pointed the way to keep us on the right approach to school planning. In Chapter 1 we studied the pupil; here in Chapter 2 we are to study the process of his education.

Unfortunately the process of education cannot be explained in as specific terms as that of canning tomatoes; for one thing the educators have a hard time agreeing on the aims and processes of education. For that matter, the architects have a hard time agreeing on the aims and process of architecture. In a way that is good: at least we have not arrived! When we do, we will stop writing books on the approach and will start preparing brochures of stock plans, a sure sign of decay.

The concept that schools are for children belongs to both architecture and education. And in both fields it presents problems of interpretation. In architecture, the greatest danger lies in an overemphasis upon environmental factors affecting the physical and emotional comfort of the pupil at the expense of adequate consideration for the educational factor—for the functional business of the school plant. That is, there is the danger of forgetting that the pupil is being made comfortable for a purpose. In elementary education the chief difficulty is a tendency toward a near-family relationship between the teacher and her young charges, which works to the detriment of necessary curricular control. In some cases such a relationship may foster an indulgent maternal attitude which does not satisfy all of the real personal needs of the pupil, particularly after the first two grades. Responsible architects and educators are thus mutually interested in schools which give full emphasis to the requirements of their educational curricula.

EDUCATION: A CHANGING PROCESS

Not so long ago—in fact, recently enough for most adults to remember, schools were almost exclusively subject-centered. The pupil was considered largely as a charge whose function it was to become an adult as soon as possible. The business of the elementary schools was to promote literacy and to inculcate a small body of basic knowledge. The business of the secondary school was mostly to prepare students for college by way of

Formality vs. Informality

23-24. There is a great difference between methods of teaching children today and those of a few years ago. Basically this difference lies in the lines of communication within a classroom. The old time belief was that learning took place mostly in a one-way line of communication—from the teacher to the pupil —except that after the pupil was expected at times to recite back the things that he had soaked up. Today it is believed that much more learning can be achieved if the lines of communication within the classroom are extended not only between the

formal academic study of those subjects now classified as liberal arts, despite the fact that only a relative few of them went on to college. The keynote of both was discipline. Teaching was formal and autocratic. Communication was from teacher to pupil except during recitation, when the direction was reversed.

School architecture admirably reflected this concept. Because the human rights and needs of the children were not given much consideration, the schools were almost uniformly uncomfortable and depressing. In plan they were no less formal than the educating process. In appearance they were made to suit the pride, ambitions, or sentimentality of the adult populace. Their classrooms helpfully regimented the pupils in stiff rows facing the teacher's raised platform from which issued all knowledge and judgment.

Yet even while the children of the early 1900's were learning their R's by rote, forces were at work changing this concept of education, until now the schools are considerably less subject-centered. The pupil, young or old, is considered as a real person with human rights and needs which must be respected. The business of the elementary school is to help the child to become socially adjusted and to encourage his individual talents, as well as to make him literate and to provide him with a basic fund of knowledge. The business of the secondary school is to help prepare the child for whatever he is going to do in life and to make him a responsible and productive voting citizen, as well as to prepare him for college, should he be one of those who go to college. The keynote of both is motivation. Teaching is relatively informal and democratic. Communication is carried on both between teacher and pupil and between pupil and pupil.

School architecture today, except where it dawdles a generation or more behind, tries to reflect this concept. Because the pupil is being considered as a person with both rights and needs, schools are more comfortable and cheerful. In plan they are informal to about the same degree that the various activities are informal. In appearance they tend to suit the emotional needs of the pupil and to express the function they house. Classrooms are designed and equipped for a variety of learning situations. In addition, the new schools are flexible in recognition of the ever-changing nature of educational theory.

Neither these generalizations nor those to follow are intended as any sort of evaluation of educational theories. They are meant to outline in necessarily general, and sometimes caricatured, terms some of the more significant changes in the educating process which have demanded corresponding changes in architecture.

teacher and the pupil, but also between pupil and pupil. In short, the children learn from each other. They learn from each other's experiences. They learn through discussing their problems with each other. How does this affect the classroom design? It simply means that if a classroom is designed to facilitate the learning process, it must be so arranged and so equipped that pupils can work in groups and communicate freely with each other. The formal and directional type of classroom must give way to the informal, non-directional type.

ELEMENTARY EDUCATION—ITS AIMS AND PROCESS

Writers of education texts and reference books disagree sharply; some schools are far ahead of others in putting contemporary educational theory into practice; schools here and there make false experimental starts. But all of this controversy and confusion is within the scope of three historical developments which together have determined the general character of today's public school system. If they are not self-evident, it is only because they are obscured by smaller arguments of interpretation or application, by the inertia of archaic practices, by the unfortunate publicity attending some of the more sensational experimental schools, and by the understandable confusion all of these in combination have created in the minds of laymen and even a few educators.

The first of these developments is the increasing realization that the child is a sensitive being with very real needs and rights whose all-around growth is peculiarly important in a democratic nation. The greatest single result of this has been a change in the aims of education beginning in the elementary school. As educators we fall out over lists of specific aims and in addition recognize that there are often differences between objectives announced by administrators and those pursued by teachers, but we agree that in general the aims have broadened and become more social in nature. Today we are interested in the development of "the whole child," and try to compensate for any deficiencies —emotional, cultural, dietary, or otherwise—in his

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THE POOR SCHOLAR'S SOLILOQUY

No, I'm not very good in school. This is my second year in the seventh grade, and I'm bigger and taller than the other kids. They like me all right, though, even if I don't say much in the classroom, because outside I can tell them how to do a lot of things. They tag me around and that sort of makes up for what goes on in school.

I don't know why the teachers don't like me. They never have, very much. Seems like they don't think you know anything unless they can name the book it comes out of. I've got a lot of books in my room at home—books like *Popular Science Mechanical Encyclopedia*, and the Sears' and Ward's catalogues—but I don't very often just sit down and read them through like they make us do in school. I use my books when I want to find something out, like whenever Mom buys anything second hand I look it up in Sears' or Ward's first and tell her if she's getting stung or not. I can use the index in a hurry to find the things I want.

In school, though, we've got to learn whatever is in the book and I just can't memorize the stuff. Last year I stayed after school every night for two weeks trying to learn the names of the Presidents. Of course I knew some of them like Washington and Jefferson and Lincoln, but there must have been thirty altogether, and I never did get them straight.

I'm not too sorry though, because the kids who learned the Presidents had to turn right around and learn all the Vice Presidents. I am taking the seventh grade over, but our teacher this year isn't so interested in the names of the Presidents. She has us trying to learn the names of all the great American inventors.

KIDS SEEMED INTERESTED

I guess I just can't remember names in history. Anyway, this year I've been trying to learn about trucks because my uncle owns three and he says I can drive one when I'm sixteen. I already know the horsepower and number of forward and backward speeds of twenty-six American trucks, some of them Diesels, and I can spot each make a long way off. It's funny how the Diesel works. I started to tell my teacher about it last Wednesday in Science class when the pump we were using to make vacuum in a bell jar got hot, but she didn't see what a Diesel engine had to do with our experiment on air pressure so I just kept still. The kids seemed interested though. I took four of them around to my uncle's garage after school and we saw the mechanic, Gus, tear a big truck Diesel down. Boy, does he know his stuff!

I'm not very good in geography either. They call it economic geography this year. We've been studying the imports and exports of Chile all week, but I couldn't tell you what they are. Maybe the reason is I had to miss school yesterday because my uncle took me and his big trailer down state about 200 miles, and we brought almost 10 tons of stock to the Chicago market.

He had told me where we were going, and I had to figure out the highways to take and also

home life; we try to make him a responsible and self-reliant social being; we attempt, partly by example, to develop in him an understanding and appreciation of democratic theory and practice; and, of course, we still purpose to make him literate and to provide him with a basic fund of knowledge, though we go about it in different ways. These differences in method, however, are not the product of the increased interest in the child alone.

The second determining historical development is the growing reflection in the schools of American pragmatism. To most educators this is synonymous with the teachings of John Dewey, though many other philosophers, American and European, must be credited at least with an assist. The American historical experience which has gone far toward leveling artificial distinctions among people, which has encouraged a feeling that the world is continually changing and must therefore be met with a continuous experimentation guided by observable consequences, and which has developed a remarkable practical and material inventiveness, has inevitably found expression in American schools. The result of this, in conjunction with both of the other significant historical developments, is a general shifting from autocratic sit-and-learn "texbook" methods to a variety of less formal methods in which the children learn by doing in a number of different group relationships with their activities often directly related to home or community life.

The third shaping influence is the close relationship between public school and community that has been peculiarly American ever since the elementary school

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the mileage. He didn't do anything but drive and turn where I told him to. Was that fun! I sat with the map in my lap and told him to turn south, or southeast, or some other direction. We made seven stops, and drove over 500 miles round trip. I'm figuring now what his oil costs, and also the wear and tear on the truck—he calls it depreciation—so we'll know how much we made.

I even write out all the bills and send letters to the farmers about what their pigs and beef cattle brought at the stockyards. I only made three mistakes in 17 letters last time, my aunt said, all commas. She's been through high school and reads them over. I wish I could write school themes that way. The last one I had to write was on, "What a Daffodil Thinks of Spring," and I just couldn't get going.

I don't do very well in school in arithmetic either. Seems I just can't keep my mind on the problem. We had one the other day like this:

> If a 57-foot telephone pole falls across a cement highway so that $17\frac{3}{16}$ feet extend from one side and $14\frac{9}{17}$ feet from the other, how wide is the highway?

That seemed to me like an awfully silly way to get the width of a highway. I didn't even try to answer it because it didn't say whether the pole had fallen straight across or not.

NOT GETTING ANY YOUNGER

Even in shop I don't get very good grades. All of us kids made a broom holder and a bookend this term and mine were sloppy. I just couldn't get interested. Mom doesn't use a broom any more with her new vacuum cleaner, and all our books are in a bookcase with glass doors in the parlor. Anyway, I wanted to make an end gate for my uncle's trailer, but the shop teacher said that meant using metal and wood both, and I'd have to learn to work with wood first. I didn't see why, but I kept still and made a tie rack at school and the tail gate after school at my uncle's garage. He said I saved him ten dollars.

Civics is hard for me, too. I've been staying after school trying to learn the "Articles of Confederation" for almost a week, because the teacher said we couldn't be good citizens unless we did. I really tried, because I want to be a good citizen. I did hate to stay after school, though, because a bunch of us boys from the south end of town have been cleaning up the old lot across from Taylor's Machine Shop to make a playground of it for the little kids from the Methodist home. I made the jungle gym from old pipe, and the guys made me Grand Mogul to keep the playground going. We raised enough money collecting scrap this month to build a wire fence clear around the lot.

Day says I can quit school when I am fifteen, and I am sort of anxious to because there are a lot of things I want to learn how to do, and as my uncle says, I'm not getting any younger."

Quote from an article by Stephen M. Corey in *Childhood Education* magazine, January 1944. Vol. 20, pp. 219-220.

had its beginnings in the earliest common school in this country. For better and for worse the American people own and operate their own schools as community extensions. Combined with the others, this influence has had much to do with the school's assuming certain parental obligations and with school activities' becoming more "practical" and experimental. Alone, it has resulted in the school buildings' being used for community purposes in addition to the education of children.

Whatever specific aims of education in the elementary school any group of educators might list, these are the primary historical forces behind those announced objectives, and on these all factions should be able to agree. Similarly, though educators will differ over specific curricular and teaching problems in trying to realize their objectives, these forces have caused changes in curricula and methods upon which they can agree as general trends.

THE ACTIVITY PROGRAM

The greatest of these from the architectural point of view, because it requires sweeping changes in design and layout as well as in space and equipment requirements, is the movement toward a fundamentally different type of curriculum. The naturally overlapping "subject-matter curriculum" and "experience curriculum" which at times seem to have been at war are now pretty well intergrated under what is generally called the activity concept. As the term implies, this concept in all its various specific forms is based upon the idea of learning by doing with concern for the interests and needs of the individual child. Beyond that, there are some differences of opinion not relevant here. To appreciate how the concept affects school architecture an examination of the class activities for one day in any new school is sufficient.

For this purpose let us examine a day's activity of Miss Jones's third grade. The following report is an adaptation of an account by Mrs. Gwendolyn Evans, a third grade teacher herself. Perhaps this little story will help us capture the spirit of the activity program and the implication it has for architecture.

It is 8:00 o'clock in the morning and Miss Jones, the teacher, is at her desk reviewing her plans for the day. She glances over the notes for a story she is to tell, checks to see if there is enough drawing material for the day, prepares a tentative schedule, and looks at the thermometer to see if the custodian has regulated the windows properly. She remembers the story in the library book she started Friday and wants to finish it before it's time for work.

The children are beginning to arrive now. They come in running happily as if they were at home, because Miss Jones wants the school to be like home and has acted accordingly, and partly because the building itself is informal and warmly friendly, not at all like the formal and institutionally cold and depressing structure Miss Jones remembers from her early school days.

The first thing little Mary does when she arrives is to hang her wraps neatly on a hanger which is just the right height for her. Then she goes to her cubicle for storing her books and things, in which she sees the red fire truck which she made and painted all by herself. In it also are her crayons, her colored paper, and her scissors, which remind her of the house she made yesterday. While she makes sure everything is neat in her locker she wonders what she will make today. She likes to do things; school is fun for Mary. She greets all of her classmates, for Miss Jones says that all children should be friendly and love one another. Miss Jones thinks how much better it is to have children come into the classroom in informal groups than it is to have them march in.

Miss Jones seats herself and the children in a circle and tells them a story about the birds which they see every day around their homes. She has the complete attention of everyone because she knows how to tell a story, because she has seated herself as one of them, and because the children are in comfortable chairs. Tom, who is large for his age, has a large chair, and tiny Virginia has the smallest chair of all. After the story each child tells about some bird that he has seen. Miss Jones notices that Tom has a slight stammer, that Dorothy should be more observant, and that Bess has a vivid imagination, and she plans to do what she can to promote the good and minimize the bad characteristics of each child. Miss Jones believes in teaching the individual, not the class. Fortunately the classroom has a nice quiet nook to give the individual special instructions.

The story is over, and it is time for work. The light but sturdy furniture is moved to one corner of the room. The unit of work this six weeks is the study of the community. It has been going on for three weeks and things are well organized. Today Miss Jones divides the class into four committees. One committee will work on building a model of the refinery which is located near the city and which employs the fathers of some of the children. The members of this committee will be learning how to use their hands. Another committee will work on a large mural which depicts the commercial activities of their city. Fortunately one entire wall can be used to tack up the brown wrapping paper on which the mural will be painted. A third committee whose members Miss Jones had decided need special drill in the language arts is to form a group in one corner of the room to practice spelling and writing such words about the community as "boulevard," "sewage," "community-house," "refinery," and "fire-station." Miss Jones told this group that as soon as each had mastered the spelling of these words he should make a sentence using each word. The fourth group is to solve a mathematical problem concerning the community. It is the

objective of this group to figure how many square blocks the community has. This is a busy period for the teacher; she has four groups on different projects, and she must have good supervision of each group. But the classroom, especially planned for informality, allows this. The group making the mural has access to water and paints within the room. The group making the model has a movable tool storage and work bench unit, and today it will be moved to the terrace for work outdoors because the weather is just right. Because of the glass wall which separates the indoor classroom from the outdoor classroom, Miss Jones can easily supervise this group. This allows more activity on the inside, and projects like building a large model need lots of space.

John asks to be excused to go to the toilet, and Miss Jones lets him go. The toilet room is adjacent to the classroom; so the children can go when they have to, just as they do at home. There is a large mirror handy for him to comb his hair after he washes his hands, a health habit which he learned in the first grade.

It is now time for the televised broadcast. The children are accustomed to these television programs and arrange their chairs so that they can see and hear everything that comes out of the receiving unit. Before every broadcast Miss Jones tells the children what is to come so that they will listen more attentively; this time she tells them they are to hear a story about trees of the community. Each child enjoys the program and has something to say after it is over.

The broadcast interrupted the activity program, but that was all right because all four groups could go back to their original tasks. Miss Jones goes over to the language group because it is the one that requires most of her attention. She introduces some more new spelling words. Some of the children will use their words in sentences, but Mary wants to write a paragraph telling about the circus she saw yesterday. Tommy, Mary's chum, will read aloud with his group and is anxious to get started, for this week he is the monitor to assign the pages and to direct the group. He likes to read and feels secure because he had a chance to select a book at his own level. After the story there is a discussion in which every member of the group participates. The other three groups do not disturb the reading group because they know that their turn will come before long.

It is now time for play; just as the children learn to work together they learn to play together. The class have organized themselves for the play period. Teams have been chosen and partners selected. The children like to play outside, for they have plenty of room where they will not disturb the classes which are studying and where they will not harm the flowers and shrubs. Before going outside, however, they stop by the cafeteria for their mid-morning snack of cookies and orange juice.

The play period is over and there is just time for some music before lunch. Each child goes to his cubicle and gets the particular instrument he plays in the rhythm band, unless it is one of the large instruments kept in a special storage cabinet. Then they all gather around the music teacher, some of them sitting on the floor. They love music class, and it's fun to have a different teacher, too. They make plenty of noise, but they are learning timing, expression, and music—and having fun, too. Every day isn't a rhythm band day. Tomorrow they will probably sing songs. Last time they all danced folk dances.

The boys and girls are back from lunch, and it is time for the relaxation every child needs during the school day. The light and sturdy furniture is moved to the walls, and each child gets his individual mat from a movable cart which can be shoved into a niche when not in use. The mats are put on the floor, a nice warm floor, even in the winter time. They lie down for a period of 10 to 30 minutes, some longer than the others. This is also story time, and Miss Jones often reads to the children as they rest. Sometimes the children take turns in telling stories. After the rest period each child folds his mat and places it back on the cart. John and Henry then push the cart into its niche. Miss Jones is glad that hers is a classroom large enough for such a rest period.

Back to work again! Mary knows that it is time for arithemetic lesson and asks Miss Jones if the class may play the drill game. Miss Jones knows that a certain amount of drill is necessary for her third graders to learn their number combinations and welcomes this suggestion. After the drill it is time for more group work. This time the children are preparing for their Science Club which will meet later on in the week. Their Science Unit is about birds. The children have already divided themselves into three groups, so they arrange their tables, desks, and chairs accordingly. They push several small tables together to make three large ones—one for each group. One group makes cut-outs of birds. Another group is writing a poem about a mocking bird. The third group is studying some stuffed specimens and measuring the sizes. The children are active, and plenty of fresh air is needed. Miss Jones opens the sliding doors, making the outside a part of the classroom.

"Mary, look! There is a bird in our tree out there. What kind is it?" Mary does not know, but George, who lives near the edge of town, tells the class exactly what kind of bird has flown into the tree in the outdoor classroom.

About this time the bell rings. Miss Jones says, "Children, it's time to get ready to catch the school bus." "Shucks!" Henry does not say it, but he thinks it.

THE SELF-CONTAINED CLASSROOM

It is apparent that Miss Jones' school has not only the new type of curriculum, but has also turned from the departmental plan of organization to that of the self-

contained classroom unit. There are good arguments in favor of both plans, but the self-contained classroom seems to be growing in popularity, at least in the elementary schools, with the teacher's capabilities being supplemented by those of such visiting specialists as the music supervisor.

Many educators argue that the self-contained classroom unit alone is not sufficient to meet all of the needs of the youngsters. Other facilities are necessary, they point out, to give the children opportunities not afforded by the self-contained classroom. Caswell and Foshay propose that a group of "service centers" —representing persons, materials, and equipment—be provided to support the general classroom, and they name five such centers as: library, laboratory-shop, art studio, music center, gymnasium, and health center. These service centers would be available to teachers to use as their classroom programs required. There would be no fixed schedules of activities. The pupil would go to a center only when he had some clearly defined purpose determined by the regular teacher of the self-contained classroom. If such an idea were carried out in an elementary school, or for that matter in the secondary school, it would have tremendous implications for architecture. It would be a difficult, but stimulating problem for architects to tackle.

The "self-contained classroom" is clear enough in definition, but what does it mean as an architectural term? Generally speaking, the self-contained classroom is cheerful and informal. It is the type of space that would be needed to house Miss Jones's class. It is bigger than classrooms used to be, and different in shape. It opens to embrace a part of the outdoors to become even bigger and even more informal. For a classroom that could have been Miss Jones's, see Case Study 44. This room has individual lockers for all of its charges, and these are arranged to provide sound barriers to noises from adjacent rooms. It has additional storage space for equipment and supplies not kept in the children's lockers. And it has plenty of such equipment. Instead of regimented desks, it has chairs and tables light enough for the children to move easily. It shares with other classrooms a piano on casters. It has a desk for the teacher, too, though it makes of that desk a work center instead of a throne. The room has its own toilet right there, not off at marching distance. There is plenty of chalkboard and tackboard surface. And the whole thing is made of durable, inexpensive, and easy-to-clean materials.

Any similarity to old-fashioned classrooms, living or dead, is purely unfortunate.

WHAT SHAPE AND HOW MUCH SPACE?

What shape should the classroom take to help carry out activities such as we saw in Miss Jones's classroom most effectively? How large should it be? Answers to these questions are running amuck. Some planners say we want square type classrooms. Others say that the conventional rectangular one serves the activity program just as well as it did the formal program. Other planners say that the L-shape best suits the educating process. But this is only the beginning. There are strong arguments for the circle, the pentagon, the octagon, the hexagon, and even the parallelogram. So what? Maybe there is a place for each of them. To argue about the shape of classrooms is about as much nonsense as it is to argue whether modern architecture should have flat roofs, gabled roofs, hipped roofs, shed roofs, or what have you. Architecture should not be limited with any definite roof shapes. Is it not the same with classroom shapes? And to think we even passed laws at one time setting the shape!

And what about the size of these classrooms? Arguments on size run from 600 sq. ft. to 1200 sq. ft. Who is right? Probably under certain conditions both extreme figures may be satisfactory. The only way that we can tell what the size and shapes of a given classroom should be is to know (1) exactly what will take place within that room (and outside of it for that matter) and (2) exactly how many children must be served. Then we will be in a position to formulate a functional shape and size for the classroom. But if we are imaginative we will formulate more than one design, because, since the cost of construction and type of construction varies with the architectural shape, we will need many designs at our disposal—to find the trilateral balance of the three main factors of school planning mentioned in Chapter 1.

A competent architect would much prefer to have a clear-cut statement, similar to the Miss Jones account, of the activities which go on within a classroom than a statement to the effect that the classroom should have such and such a shape with such and such dimensions. When given a specified size and shape for a classroom, the architect immediately loses part of his control over the design of the structure, and therefore over construction cost. In meeting the tight budgets of these days he is going to need all the freedom of design he can get. It seems reasonable to believe that the educator should take the lead in specifying the classroom function and that the architect should take the lead in specifying the architectural shape to fit that function. Both architect and educator must work together because their responsibilities overlap and because Form cannot be separated from Function.

It has been said that the size and shape of the classroom cannot be determined until the number of pupils has been established and the kinds of activities have been set. In order to have a basis for determining how large and what shape a classroom should be the architectural staff of the Texas Engineering Experiment Station, together with L. S. Richardson, Superintendent of the A&M Consolidated School District, College Station, Texas, conducted an experiment in-

volving a first grade class. The researchers worked with Mrs. Betty Moon, the first grade teacher. First they established the number of pupils—in this case, thirty—which tied down one of the two variables. Next they reviewed with Mrs. Moon the kind of activities which she carries on in her classrooms, asking such questions as: Will there be formal seating? Will the pupils work in groups? Will visual aids be used, and if so, what kind? Will art work be carried on in the room? Will there be special activities such as building large models or having little dramas within the classroom? To these many more questions were added in an attempt to tie down the second variable.

Then a plan was formulated to record the size and shape of each of the activities which might be carried on during the course of a week. This was done by photography, and the results are shown on the following pages.

A STUDY OF CLASSROOM ARRANGEMENTS

The first photograph shows the conventional formal seating arrangement. Mrs. Moon pointed out to the research team that, although this type of seating arrangement is associated with old time teaching methods, there are occasions suited to this arrangement in up-to-date programs. It is good for tests, writing drills, and so on. Note how little space it takes: only 20 ft. by 15 ft., or 10 sq. ft. per pupil.

Now look at Photograph 26. Here Mrs. Moon is having the children work in groups of six, and has the furniture to do it. This particular arrangement, according to Mrs. Moon, is used quite often. Some of the groups may be studying while others are being given special drills. This arrangement takes somewhat more space than arrangement No. 1. If the tables were closer together not so much space would be involved, but Mrs. Moon wanted room enough to move demonstration equipment to any of the tables.

Photograph 27 shows another group arrangement. Mrs. Moon is seen at the small reference table with two students. The large group is having a committee meeting to see how the class could build a model of a home as a part of the current unit study. The other group is studying what will go into the home. Photograph No. 28 shows the entire group gathered in an informal arrangement to discuss the current project. In this arrangement each child has the opportunity of talking to, as well as of being near, every other member of the group. It is a democracy in action. Even Mrs. Moon has her place among the students rather than over them.

Now look at Photograph 29. The space has been cleared of furniture because it is time for folk dancing. The space involved here appears rather small, but for this particular movement of the folk dance not much space is needed. Other movements might require twice this much.

The next view, Photograph No. 30, shows the class looking at a movie about some phase of the unit work. It might be a picture about the home or visual aids on how to read. Because of the limited angle of the projector the class is seated close together as in a regular theater. Actually the space for seating such as group is very small, less than 7 square feet per pupil.

Photograph No. 31 shows the class putting on a little play. The two young actors are seen performing on the stage built by the students themselves. Mrs. Moon, like other good teachers, believes that a little dramatization like this one is a wonderful learning medium as well as a splendid opportunity for self expression.

The next classroom scene, Photograph 32, shows a general activity arrangement. A small group is doing art work, and the pupils are working at their easels. There is also a small group working at the circular reference table. The rest of the members of the class are doing various things at the large table, which consists of four of the tables shown in Photograph 2. The space required for this last teaching setup is shown on accompanying diagram.

In Photograph 33 the class is seen engaged building the model of the house mentioned before. The group of boys at the lower right is building the roof, the girls on the upper left are making the curtains. The other groups are performing other tasks connected with this project. This learning situation requires considerable space, as the accompanying sketch shows.

The last photograph shows the six large tables arranged as one large table for group study and activity. One of the students, who is giving a demonstration at the chalkboard, has the attention of all. The use of tables in this manner provides facilities for innumerably learning activities.

Now what do we have? If we superimpose all of the diagrams of the ten classroom arrangements, what is the composite picture? As the sketch (35) shows, all of these activities come within an area of 26 ft. by 28 ft. That is pretty close to a square or circle. Perhaps this is the reason why some planners believe that a square seems to be the best shape for a classroom. If, for structural reasons, this composite shape had to be squeezed down a little on one side, how much would it hurt the educating process? Probably not very much. Then what have we learned from this study of classroom arrangements? We have learned that in this particular situation—Mrs. Moon's class, with Mrs. Moon teaching, and with Mrs. Moon's thirty children—a teaching space approaching a square seems to be desirable. But should all classrooms take on that exact shape? Not necessarily. What about the space required for equipment, for storage of materials and books? What about the space in which to place the desks and chairs to make room for some of these activities? What about wardrobe storage? By the time we add the spaces for these to the

25-34. The following series of photographs, posed by an actual elementary class, demonstrates the space requirements of typical classroom activities.

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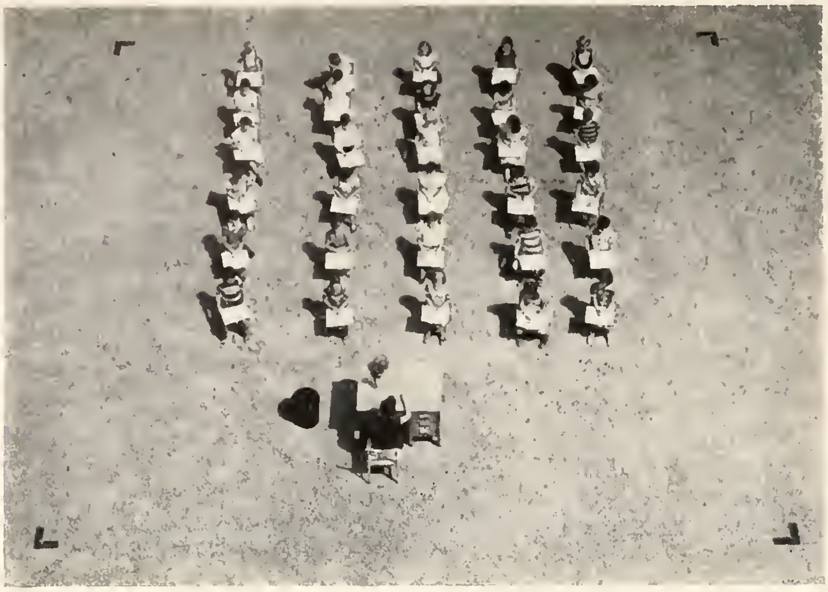

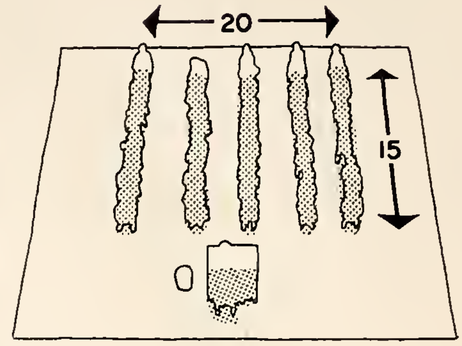

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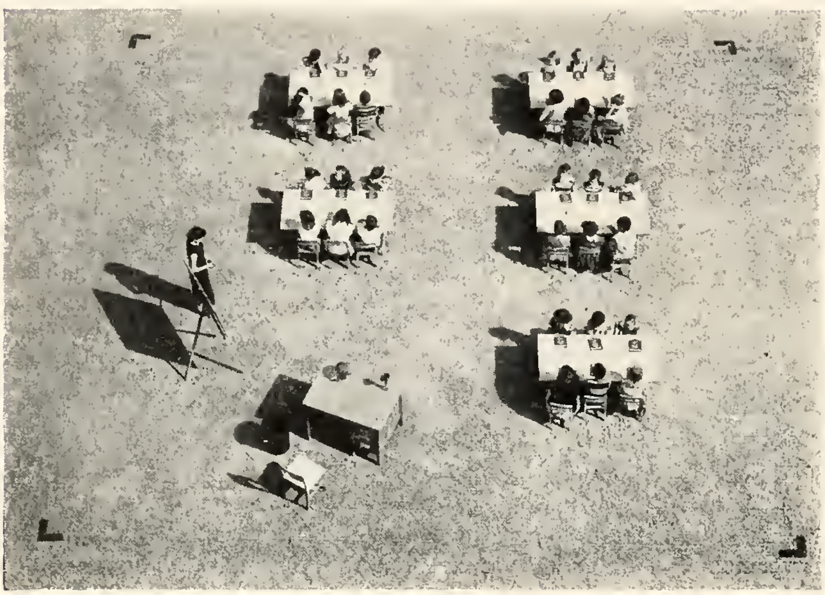

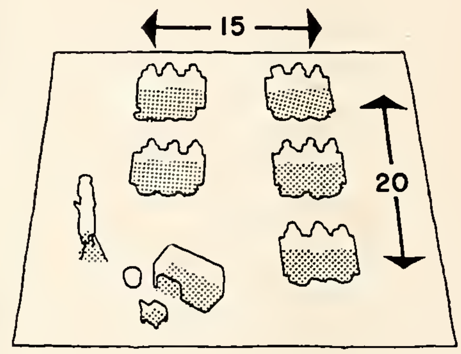

26 ft. by 28 ft. shown here, the classroom probably could take on any shape—square, L-shaped, circular, hexagonal, or what have you. So it is the furniture and equipment that really makes the difference. Their arrangement helps determine the classroom shape.

The presence of furniture and equipment also influences the size of a classroom. The teaching activities themselves take up a space 26 ft. by 28 ft. or about 25 sq. ft. per pupil. By the time the space required for storage of materials, equipment, and wardrobes is added, this figure will go up considerably. The recommendation of 35 sq. ft. per pupil, proposed by the author in 1941 in *Space For Teaching*, probably still holds and is as good as any other figure to use for an activity type classroom. Therefore the conclusions based on this study of classroom size and shapes are as follows:

Classrooms should have at least 35 square feet per pupil to facilitate an activity program, the exact shape to be determined by the arrangement of the equipment, furniture, and storage facilities.

This study also indicated that there should be a minimum figure set for the width of the main teaching space. The 26-ft. figure seems to be as good as any. Possibly it could be as low as 24 ft., but certainly to go much lower than that, where 30 children are involved, might hamper the activity program. Another thing to remember in connection with this study is the fact that these measurements were made on the first grade class. A sixth grade group would undoubtedly

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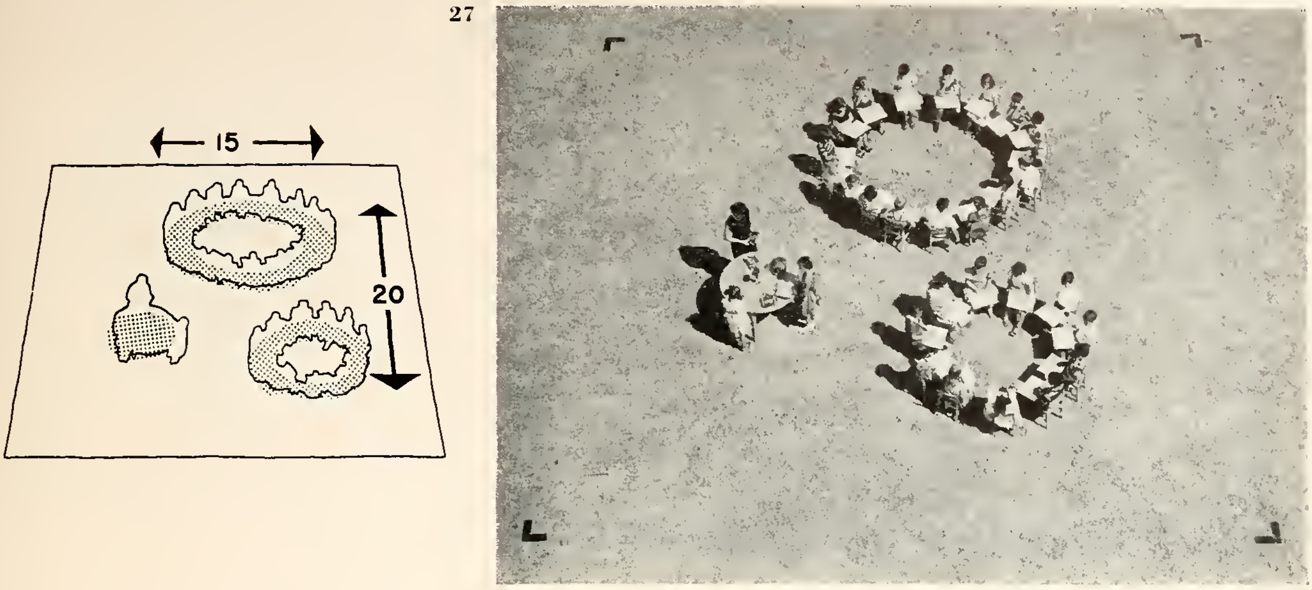

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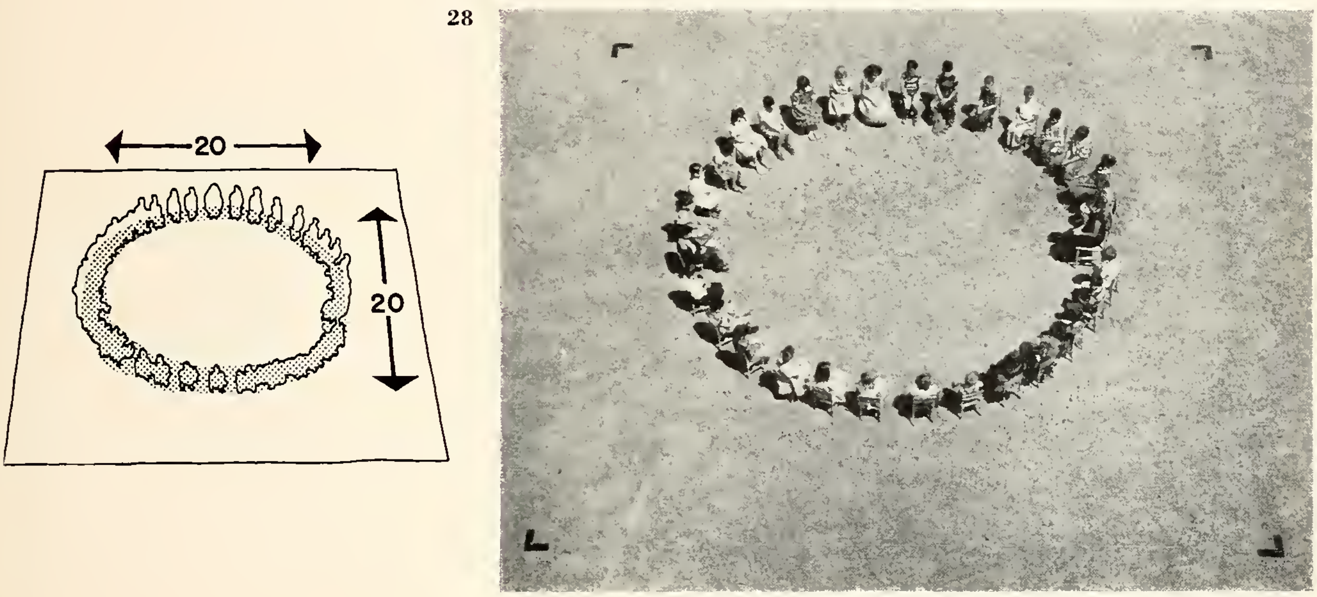

take more space for the simple reason that the children are larger and require more room to move in as well as larger furniture and equipment. So the 35 sq. ft. per pupil recommendation should be considered only a minimum condition.

This space study for a classroom is only a start. There should be others made for all spaces of the school plant if the approach to school planning is to be thorough. In the elementary school it is particularly important to make such detailed studies of eating spaces, assembly areas, and recreational rooms. But in the high school it is even more important to do these basic studies because such information is greatly lacking. These kinds of studies should be made particularly for home-making units, science laboratories, art units, business suites, and shops. These studies will be a little harder to do than those for the elementary school, because the aims and processes of secondary education are somewhat harder to tie down, but there is really no difference between approach to solving architectural problems of the elementary grades and the approach to solving corresponding problems of the high school.

SECONDARY EDUCATION— ITS AIMS AND PROCESS

Despite the progress in educational theory and the efforts of a growing number of educators, the lag of practice behind thought—both in classroom procedure and in housing—is far more widespread in the secondary schools than on the elementary school level. Even the

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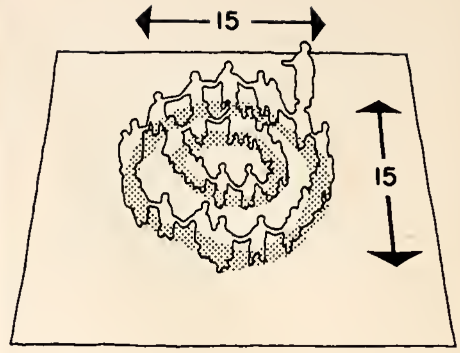

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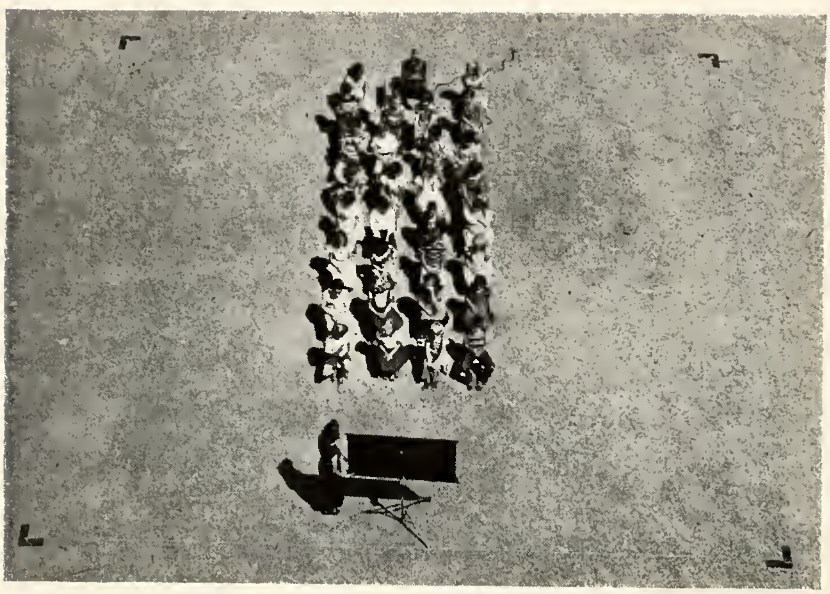

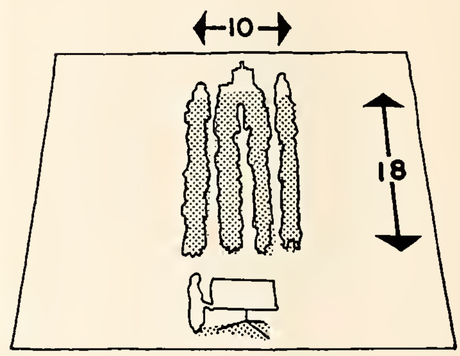

communities which are building workable elementary schools very often burden themselves with new high school buildings which are obsolete before they are erected and which cannot possibly be made to fit the educational program to be followed during the life of the building. Why? It is hard to say, for the same historical forces that have made themselves evident in elementary school programs and buildings are at work on the secondary level.

These forces have made themselves felt, and their influence is spreading. Soon even the most reluctant secondary schools will have to face historical fact. It is largely a matter of time, and very little time, for old-fashioned line-'em-up-and-drill-'em schools being built now are certain to be hopelessly unworkable long before they have completed their normal span. Just as recognition of the human nature, needs, and rights of the child has modified the aims of education in the elementary school, so has it made those of the secondary school broader and more realistic than they used to be. The difference is only that secondary schools have been somewhat slower to react to these influences.

Education in the secondary schools that are really today's schools still prepares students for college, but not so much in the academic, college-directed way it once did. These schools realize that only about one child in five or six goes to college, and they feel a strong responsibility to the great majority who do not. To-

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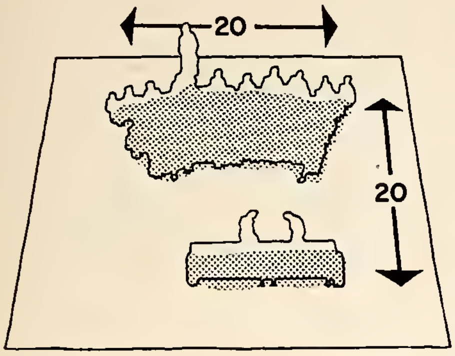

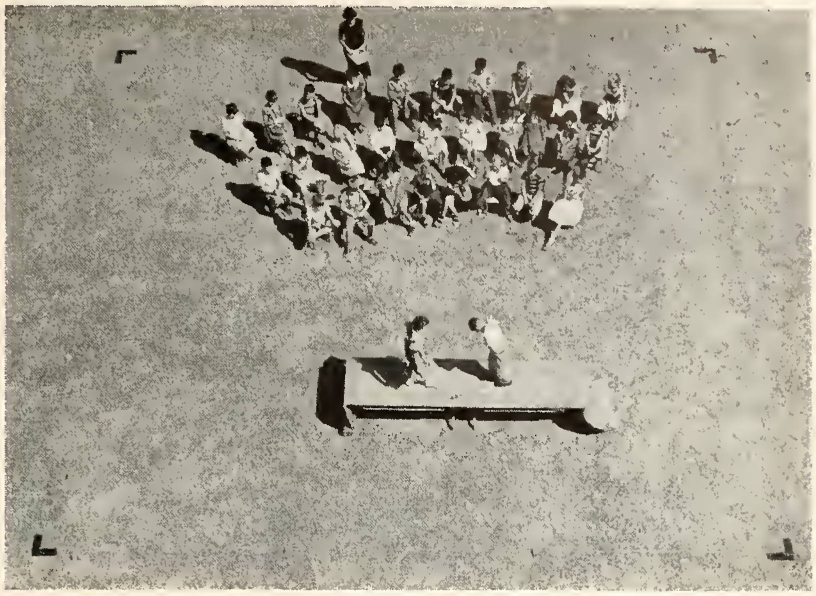

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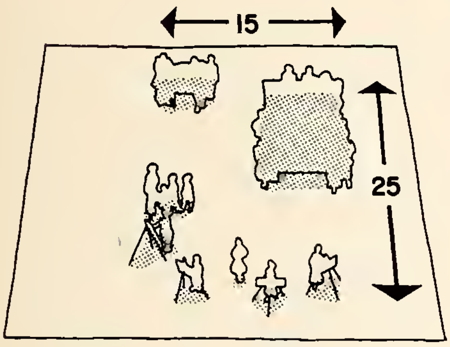

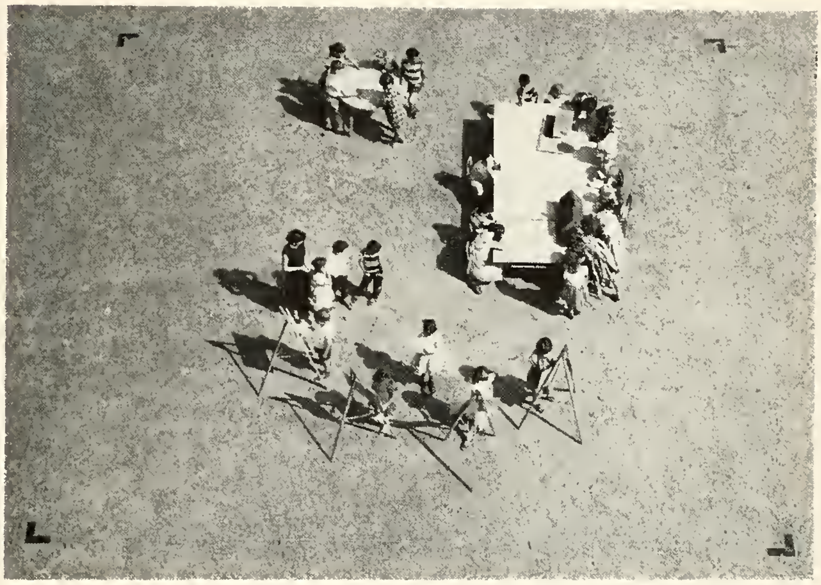

day's secondary school tries to prepare each student for life as he is going to live it. It recognizes its responsibility to meet all the educational needs of the children and to make those children competent to do their share in supplying the needs of the adult society of which they are so soon to be a part. Precisely what are these needs? In a booklet called *Planning For American Youth*[14] the National Association of Secondary School Principals lists them as they are conceived by trained educators who ought to know what they are talking about:

THE TEN IMPERATIVE NEEDS OF SOCIETY

1 Society needs to be organized and governed so that differences will be respected and peace and political stability shall prevail among nations.
2 Society needs a free economic system which supplies the basic needs of people without interruption.
3 Society needs to develop a condition which facilitates cooperation among labor, government, farmers, and industry; which promotes free discussion of differences; and which enables them to reach agreements for cooperative planning and action.
4 Society needs to make it possible for organized business and labor to share the benefits of production on terms reached by bargaining among themselves.
5 Society needs to provide opportunities for individuals to work continuously at living wages and

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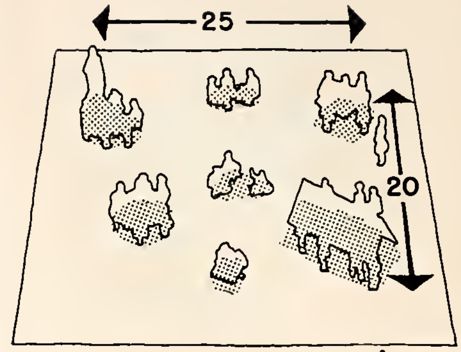

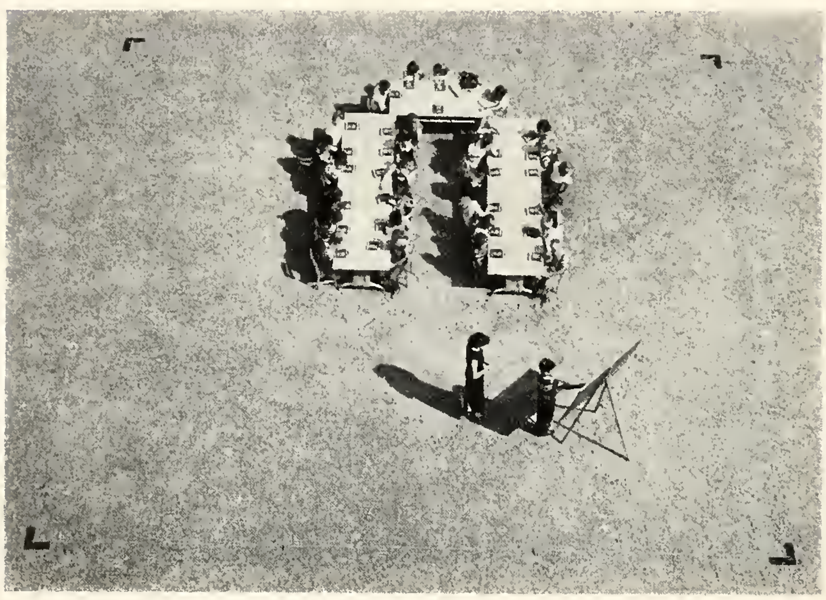

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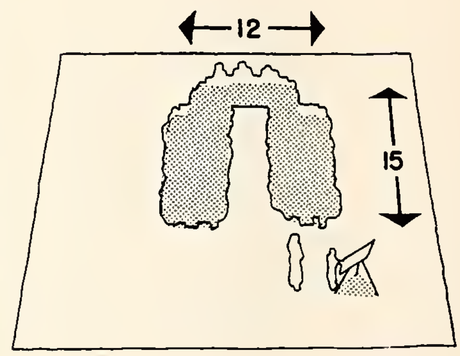
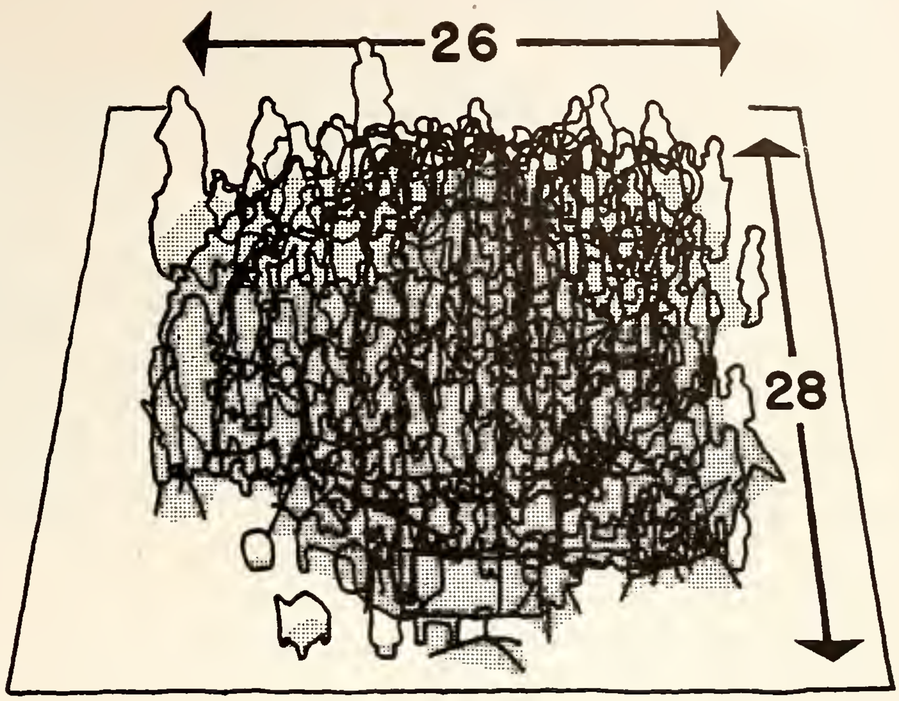


enjoy security after they have passed their productive period in life.

6 Society needs to develop loyalty to the principles of democracy, to protect individual freedom of thought and expression, to assume justice to all its citizens, and to develop independent people free from harmful propaganda and uniformity.
7 Society needs to make it possible for people of all races, colors, and creeds to be respected, with equal opportunities for work, legal protection, and education.
8 Society needs a strong popular government to protect the welfare of all its citizens from illegal practices or irresponsible groups.
9 Society needs to protect and replenish its natural resources so that they may not be wasted or exhausted.
10 Society needs to preserve the basic social institutions of home and family and church and school so that fundamental social, moral, and spiritual values may be learned, cherished, and perpetuated.

These "needs of society" have been with us for some time, and the chances are we will be confronted with them for a long time to come. It is the responsibility of the school, therefore, to see that each of our boys and girls in high school is fully aware of his responsibility to understand and to deal effectively with these needs. It is also the responsibility of the school to meet the individual "needs of youth" to make them competent

35. Here is the composite result of the photographic studies concerning classroom shapes and sizes. All of the classroom arrangements come within an area of 26 ft. by 28 ft., which allows about 25 sq. ft. per pupil. After space for storage of equipment, wardrobes, and furniture has been added, the activity type classroom will take as much as 35 sq. ft. per pupil. Although this composite diagram indicates that the shape of the activity space approaches the square or circle, the thing that will probably govern the final shape of a classroom is how the added spaces required for storage will be arranged for efficient use.

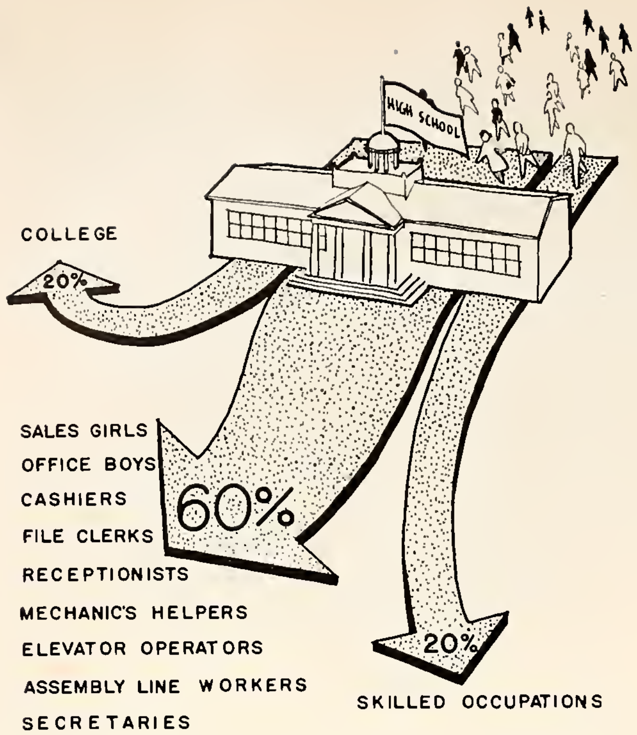


to deal effectively with the common problems of society. What are these needs of youth? They are listed in *Planning for American Youth*[14] as:

THE TEN IMPERATIVE NEEDS OF YOUTH

1 All youth needs to develop salable skills and those understandings and attitudes that make the worker an intelligent and productive participant in economic life. To this end, most youth need supervised work experience as well as education in the skills and knowledge of their occupations.
2 All youth need to develop and maintain good health and physical fitness and mental health.
3 All youth need to understand the rights and duties of the citizen of a democratic society, and to be diligent and competent in the performance of their obligations as members of the community and citizens of the state and nation, and to have an understanding of the nations and peoples of the world.
4 All youth need to understand the significance of the family for the individual and society and the conditions conducive to successful family life.
5 All youth need to know how to purchase and use goods and services intelligently, understanding both the values received by the consumer and the economic consequences of their acts.
6 All youth need to understand the methods of science, the influence of science on human life, and the main scientific facts concerning the nature of the world and of man.
7 All youth need opportunities to develop their capacities to appreciate beauty, in literature, art, music, and nature.
8 All youth need to be able to use their leisure time well and to budget it wisely, balancing activities that yield satisfactions to the individual with those that are socially useful.
9 All youth need to develop respect for other persons, to grow in their insight into ethical values and principles, to be able to live and work cooperatively with others, and to grow in the moral and spiritual values of life.
10 All youth need to grow in their ability to think rationally, to express their thoughts clearly, and to read and listen with understanding.

This document listing the ten imperative needs of youth is probably the most valuable planning instrument there is today. It is an instrument that can be used not only for planning the curriculum, but also for planning the building itself. It is one of the few bits of a philosophy of education upon which most educators can agree. As far as the planning of high school buildings is concerned, these "needs" represent a base line from which to work. Curricula will change and make inflexible school buildings obsolete, but these ten imperative needs will remain for some time. At least, that is the opinion of Paul E. Elicker, Executive Secretary of the National Association of Secondary School Principals* who says: "Although I cannot place myself in the role of a prophet, I am inclined to think that these needs are so sound and so general that they will be accepted for a rather long time. There may be some slight and minor changes in them, but I believe that their acceptance has been so firm that they will be before our school people for quite a number of years." If we could design



36. This diagram helps to show what lines of occupation our boys and girls follow after they leave high school. This sketch has been adapted from a pamphlet, "High School—What's In It For Me?" produced for the Commission on Life Adjustment Education, Federal Security Agency, Office of Education.

high school buildings to facilitate the fulfillment of these needs and make them flexible enough to provide for a changing curricula, then we would have high schools worth talking about.

TEN IMPERATIVE NEEDS PUT TO PRACTICE

To show these ten imperative needs put to architectural use, and to illustrate some of the difficulties encountered by many architects who plan secondary schools, the planning story of the new high school at Norman, Oklahoma, should serve as well as any. This school was constructed on a forty acre plot in a good location, and was designed to house from 500 to 600 children. Mr. Don Garrison was Superintendent of Schools. The firms of Perkins and Will and Caudill, Rowlett, Scott and Associates were the architects.

The architects knew that for several reasons many eyes all over the country would be on this project, and they determined to make the Norman High School an example to illustra te their fundamental tenet that it is the *approach*, not a set of specific conclusions, that really counts. Accordingly, they did *not* look at any new high school plants to see what other architects were doing. In the first place, they realized that it would be very difficult to evaluate these schools, and in the second place, they were afraid they might be too easily influenced by solutions. Instead, they moved a contingent into Norman to find out just what the problems were for that particular school.

The group set up a temporary office in Norman and arranged immediately for conferences with the high school teachers and with superintendent, whose splendid and inspirational cooperation had much to do with the success of the project. These conferences resulted in the architects' knowing pretty well what was to go on within the high school plant for at least the first two years. Upon Mr. Garrison's suggestion, the architects wrote to several educational leaders to obtain information as to what the future might bring into the secondary school program.

* by letter.

THE STUDY OF OLD HIGH SCHOOL PLANTS . . .

While waiting for the replies, the architects studied not new, but old high school plants to see how they functioned throughout their life spans. In doing so they became particularly interested in the Classen High School in Oklahoma City. During the preceding fifteen years that school had changed considerably, classrooms had been converted into offices, offices had been changed into classrooms, shops had been added, cafeterias had been moved—all for only two reasons. First, the process of education had changed; sixty changes in courses had been made with both additions and deletions in the curriculum. Second, enrollment had fluctuated. That old school illustrated that a high school plant is never completed; it is always in a process of change, expansion, or even contraction. They found that another high school, this one in Olympia, Washington, had undergone even more drastic structural changes during the preceding ten years. An auditorium had been converted into four classrooms, sliced both vertically and horizontally. A gymnasium had been divided horizontally with a shop provided on the first level and a cafeteria installed above it. A stair well had even been converted into a counsellor's office, with surprising success.

. . . TO THE MEANING OF FLEXIBILITY

The study of these old buildings taught two significant lessons. The first was that the planners must make certain their new building could be adapted to suit inevitable educational changes. The second was that it would have to accommodate changes in enrollment even beyond the readily predictable future. All of this adds up to FLEXIBILITY, the watchword of Matthew Nowicki. Nowicki used to preach that architects could be divided into two groups—those who practiced functional exactitude, and those who practiced flexibility. Members of the first group believed that the truth of architecture was the exact expression of every function, and that when a building became technically obsolete, it was to be replaced by a more efficient one. The second group,

37-38. Schoolhouses are more than mere storehouses for pupils. The good schoolhouse provides facilities for promoting the social aims of education as well as the academic and physical. Here are examples of social centers—outdoor and indoor.

he said, believed that since the function of any building changes from year to year, each should be designed to allow changes to be made efficiently and economically without marring the beauty or distorting the truth of expression. (Those readers who are architects might be interested in an excellent article called "Composition in Modern Architecture," which was written by Matthew Nowicki shortly before his death in an air accident, and appeared in the March 1949 issue of *The Magazine of Art*).

TEN IMPERATIVE NEEDS—ARCHITECTURAL CONSIDERATIONS

The replies the architects received from the educators to whom they had written were not, and could not have been, accurate enough to foretell exactly what would be taking place in the proposed school in, say, 1960 or 1970, but they did help provide a guide. For a surer long-range guide the architects turned also to the document mentioned earlier, "The Ten Imperative Needs of Youth." They studied these one by one, and found that interwoven through them was the warp of social living. This accent on the social aspect of education shows that learning facts and skills is not enough; equally important is knowing how best to use these facts and skills. The listed needs point out very clearly that boys and girls of high school age must learn to work and play together. They also suggest that children of high school age must learn to discuss their problems together intelligently if they are to help our form of government function well. In other words, these needs showed the architects of the Norman High School that the educational program should be a *living experience* in which it is as important for the pupils to get along with each other as with their teachers, and in which the pupils can learn from each other as well as from their teachers. The list indicated that a high school plant should be a community for boys and girls. This meant that, if possible, the proposed Norman High School would be a social and recreational as well as a cultural center for the youth of Norman. The problem, in this connection, was to make the school plant so attractive, and equipped and arranged in such a way, that the boys and girls would actually want to spend most of their time in it rather than in other and possibly less desirably hangouts.

Only at this stage did the architects decide it was safe to look at new schools, because by this time they had a pretty good idea of how a new high school should function. They report that except in a few cases the survey was disappointing. Most of the schools they saw were only old school stereotypes in modernized slipcovers, and served only to justify the architects' general policy of leaving to the eclectics the business of making mistakes out of other people's ideas.

Up to this time, the architects had not drawn a line of any kind of sketch because they had not known just what the problem was Reasonable as this seems, it is in violent contrast with the usual procedure. Ordinarily school boards at the outset require architects to submit sketches for solutions of problems not even determined, and architects submit hastily prepared sketches which say, "If we get the job, this is the way we would do it," before they or anybody else have any real idea of just what the problems are.

The architects for the Norman High School spent many days trying to determine the specific building problems. Only then were they ready to set down on paper a statement containing the salient considerations for the design of the school—a statement offering a realistic basis for design, but still no sketches. These considerations are as follows:

FIRST CONSIDERATION
THAT HIGH SCHOOL POPULATION WILL CONTINUE TO GROW AND THAT COURSES OF STUDY WILL CONTINUE TO BE ADDED TO OR SUBTRACTED FROM THE CURRICULUM: Therefore the school must be designed so that it can be expanded economically and efficiently without marring the beauty of the school.

SECOND CONSIDERATION
THAT WITHIN EACH INDIVIDUAL SUBJECT, SUCH AS HOMEMAKING, ENGLISH, OR SPEECH, THERE WILL ALWAYS BE CHANGES IN TEACHING TECHNIQUES: Therefore classrooms, laboratories, and shops should be designed for economical and efficient adaptations to these changes.

THIRD CONSIDERATION
THAT HIGH SCHOOL STUDENTS WILL SPEND AS MUCH TIME IN HALLS (over an hour a day) *AS THEY DO IN ANY ONE CLASSROOM OR LABORATORY:* Therefore halls and other circulation areas should be designed to help achieve the aims of the educational program. (Note: Perhaps this consideration provides the fundamental difference between the high school plant and the elementary school plant as we know them now although the future may erase this difference).

FOURTH CONSIDERATION
THAT A WELL-BALANCED EFFECTIVE PROGRAM OF EDUCATION WILL ACCENT COMMUNICATION AMONG STUDENTS IN THE CLASSROOM AS WELL AS COMMUNICATION BETWEEN THE TEACHER AND THE STUDENT GROUP: Therefore teaching areas should be designed to allow flexibility of seating arrangement. (Note: This is one of the most difficult jobs that the architect has—to provide a classroom in which no matter where the student is seated, he will have proper seeing conditions and adequate ventilation.) The Home Room Program, particularly, should be given important consideration in the design of classrooms, since such a program encourages informal seating.

FIFTH CONSIDERATION
THAT THE SCHOOL PLANT WILL BE USED THE YEAR AROUND FOR COMMUNITY IMPROVEMENT, EDUCATION AND RECREATION: Therefore the school plant should be designed to facilitate community use. Translated into planning techniques this means proper zoning of the main architectural areas. For example, those areas which are to be used by both students and the public, such as the gymnasium and auditorium, should be grouped in one zone for efficient use and economical maintenance.

SIXTH CONSIDERATION
THAT THE SCHOOL PLANT SHOULD BE A REAL SOCIAL CENTER FOR THE BOYS AND GIRLS OF HIGH SCHOOL AGE: Therefore the school plant should be planned and equipped in such a way that the students will consider it the most desirable place in the community to learn, work and play.

The architects had only then reached the point at which they could attempt to translate the educational needs into architectural form, the point at which they could start sketching for ideas which would facilitate the educational program. The following sketches made by the author were the result; they are not preliminary plans; they represent a process, not a result, and they are included here for that reason only. The sketches are taken from pages in a note book and the large numerals represent page numbers. The smaller numbers (such as 1A, 1B, and 1C) designate specific sketches or ideas. Following the sketches are comments concerning each with reference made by use of these numbers. Note that each one relates to one or more of the six salient considerations.

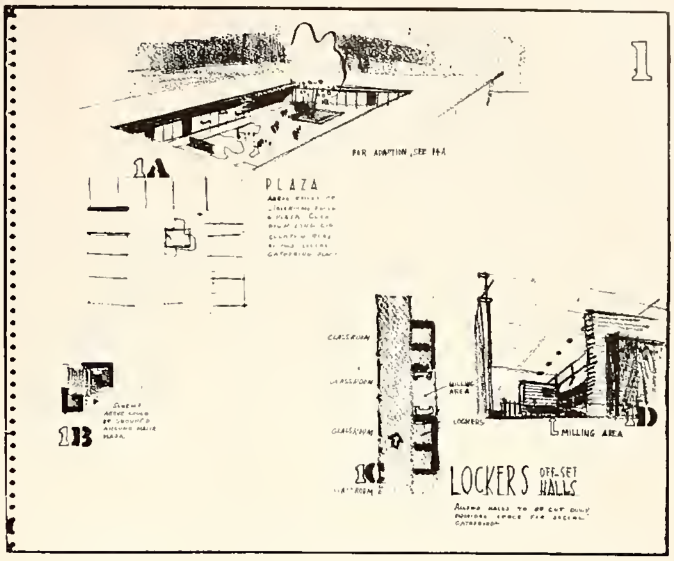
The preceding account was only the beginning, up to the making of the basic plans for the Norman High School. The whole story would be entirely too long and too detailed to be included here. More than twenty planners spent many hours studying the natural lighting problem alone, and the same could be said of nearly every other part of the design. This much of the story has been told here to illustrate the importance of approach.

THE CONCEPT OF THE SOCIAL CENTER

Before leaving the Norman High School a word should be said about the specific manner in which the social aspect of the Ten Imperative Needs found its place in the architecture. By stroke of good luck the planners of this school were fortunate enough to have Antony Part of the British Ministry of Education, who at the time was visiting in this country, participate in the final development of the basic scheme. His inspiration and gentle guiding hand pointed the way to explore the architectural possibilities of a school plant to serve the social needs of the high school boys and girls. From the discussions in which he participated came the idea of the "social center" or "center" as it is called. It will be described here briefly because of its relation to the Ten Imperative Needs. See the photograph of the model with designated areas. The area designated as "A" is the Center, a large space 42 ft. by 160 ft., the main concourse of the school plant. The Center, with floor to ceiling glass walls on one side, opens to the east onto a large social court "H" surrounded by Cafeteria "E" and Classrooms "D." Adjacent to the Center are the Library

Planning With Sketches

39. The following sketches represent a planning process used by the author in designing the high school in Norman, Oklahoma. The sketches are taken from pages in a notebook, and the large numbers represent page numbers. The smaller numbers (1A, 1B, 1C, etc.) designate specific sketches or ideas. Accompanying the sketches are comments, with reference made by use of these numbers. Note that each one relates to one or more of the six salient considerations.

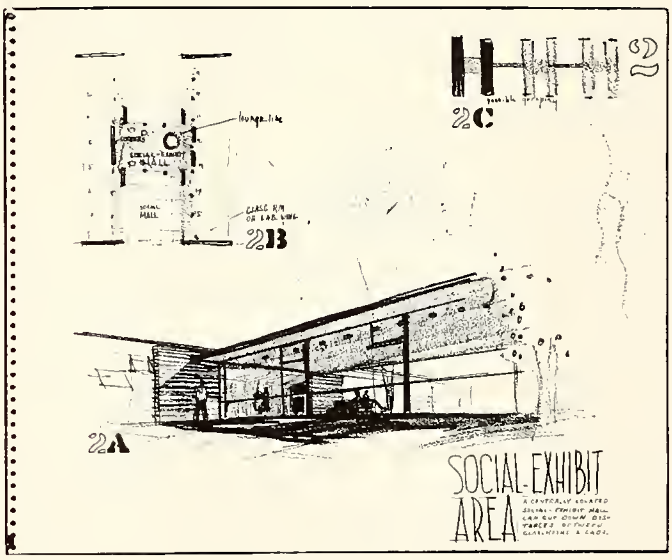


COMMENTS ACCOMPANYING THE SKETCHES

Sketch 1-A: Here is an idea for an arrangement of classrooms that can be used effectively in the design of the high school. In this case, classrooms are arranged around a PLAZA. The arrangement has two outstanding advantages: (1) efficient circulation between classrooms, (2) a social gathering place. This scheme stems from the Third Salient Consideration. The PLAZA will give the student a place where he can meet and talk with his friends. The scheme will help to eliminate undesirable meetings in private cars, the local dives, or the corner drugstore during lunch and off-period hours.

Sketch 1-B: This diagram shows how scheme 1-A can be incorporated into a major layout plan.

Sketch 1-C & 1-D: Here is another scheme based on the Third Salient Consideration. Small locker nooks and lounges have been provided adjacent to the main circulation hall. Congenial groups have places to meet and talk about everyday living problems, as well as academic problems. By keeping the lockers out of main circulation areas, the size of halls can be cut down considerably. In such a scheme these small group lounges can be used to foster art appreciation through inter-changeable good prints of masterpieces. Not only would these lounges be good places to hang pictures, but also they could be used for display of material on such subjects as art, science, literature, or social studies. Also, the individual lounge would be a good place to read and study. For development of this scheme, refer to Case Study 10.



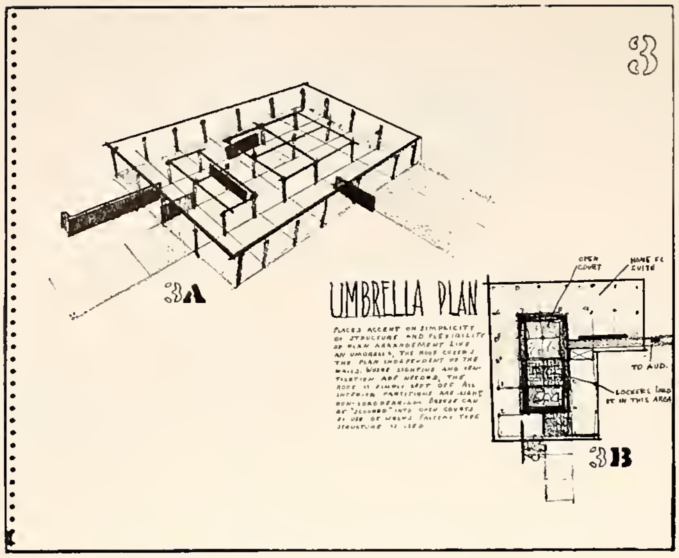
Sketch 2-A: Here is a scheme that serves the same purpose as 1-D, but in a different way. Instead of small individual lounges there is a Social-Exhibit Hall. The lockers are grouped around this large gathering place which is situated where the majority of students will pass through it on their way to classes. This is a wonderful place to have traveling exhibits, entertainment for small groups, or set-ups of visual aids on any subject.

Sketch 2-B: Here is the plan for this scheme. Note the Social-Exhibit Hall is the connecting element between two classroom wings. By such a location the distance between classrooms and laboratories can be cut down considerably.

Sketch 2-C: Here is a possible grouping plan for 2-B. The plan offers proper expansion by individual units; the layout grows like a family—one at a time.

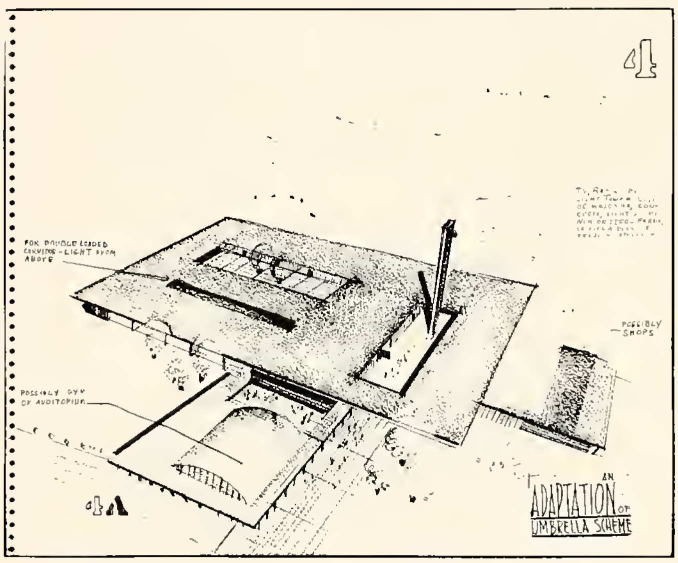
"F," the Administration Unit "G," the Gymnasium "B," and the Auditorium "C." The Center idea grew out of the planners' joint feeling that a school does need an informal area for social interchange among pupils at the high school level. Inasmuch as students frequently return to their lockers between classes, "it seemed logical to relate the lockers to such a social center, thereby expanding the capitalizing upon a natural gathering place." This kind of thinking, expressed in the words of Phil Will, took the lockers out of the halls and placed them in this social area. The lockers were designed to be free-standing. In this great hall, the "living room of the school and the community," the students and the adults will hold every kind of function, from student "bull sessions" to formal lectures, from quiet reading periods to gay socials. Superintendent Don Garrison says that the Center will be equipped with the furniture of a first class lounge, and that before he and the students are through with fixing up this living room of the school, "the Norman High School will be a place the pupils can really call their second home."

But what about the cost of this large area within the school plant? What about the tri-lateral balance of the Trinity of School Planning as mentioned in Chapter 1? Here is the way the planners justified the space from the viewpoint of economy. First, they reasoned, there had to be a corridor there to start with. So in essence the Center is an oversized corridor which serves (1) as a

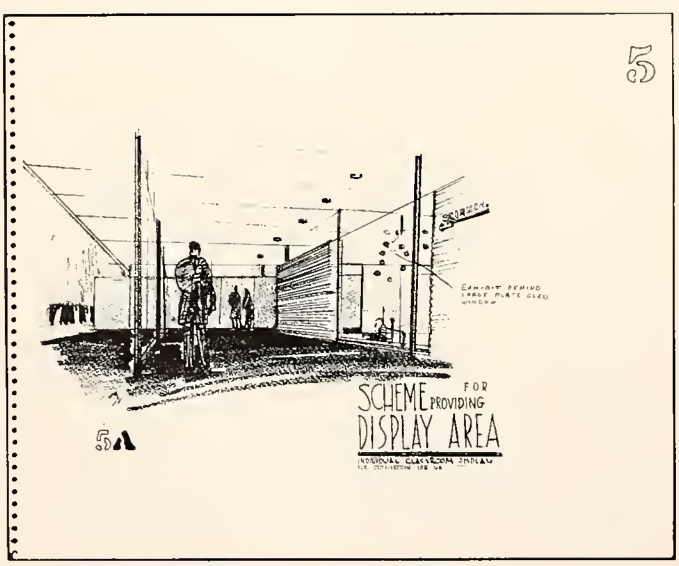


Sketch 3-A: This is a diagram plan for a structural system. The system is essentially an umbrella. The roof covers space without having any structural relationship to the walls and partitions. This scheme has been brought about through the First and Second Salient Considerations. If the educational program necessitates a change in the building, such as making a room larger or smaller, it can be done efficiently without great cost. Such a scheme permits innumerable classroom arrangements.

Sketch 3-B: This sketch shows a possible plan arrangement where classrooms are grouped around a court. It is similar to sketch 1-A. All interior partitions can be light, non-load bearing walls. Exterior walls can be of any type since they do not hold up the roof. Where lighting or ventilation is needed, the roof is simply left off for a court; however, great care should be taken to provide architectural elements for scooping the prevailing breeze into these courts and wall openings.

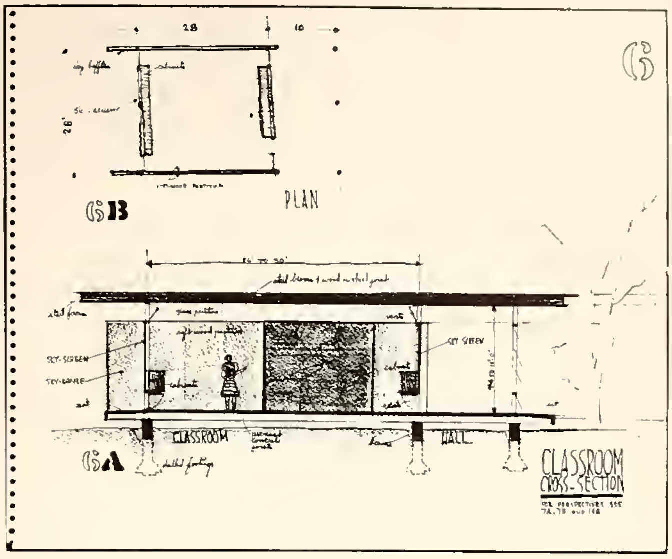


Sketch 4-A: Here is an adaptation of the umbrella structural scheme as explained in sketches 3-A and 3-B. A beautifully unified school plant is the result. A few of the other ideas such as the one shown in Sketch 1-A have been incorporated in the sketch. A main PLAZA, as well as individual courts is included. Note the tower. Even this architectural element can be justified through the school program. It could be an antenna for radio and television. In the very near future Oklahoma City is sponsoring an educational program for local school children. In fact, a modern studio has recently been completed in one of the high schools. Why shouldn't this school reap the benefits of a program paid for by the people of Oklahoma City? The tower might also have lights like those on football fields for lighting the PLAZA and surrounding areas. It could be equipped with loud speakers and a "victory light." This sketch is not the proposed Norman High School. It is just a result of thinking with a pencil.

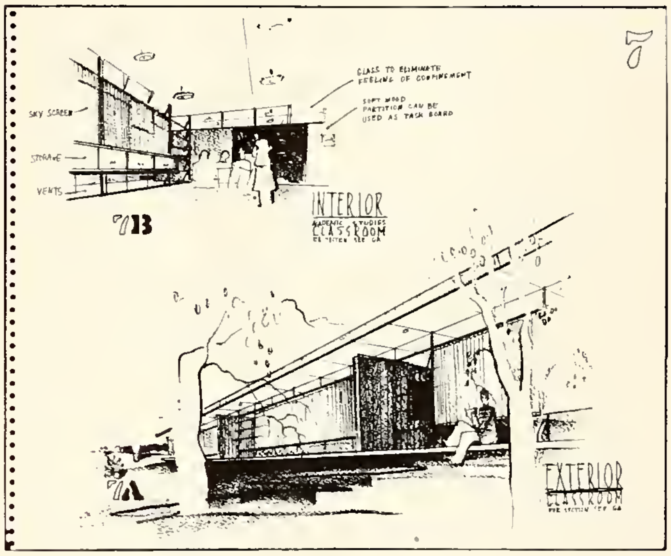


Sketch 5-A: Here is another scheme which relates to the Third Salient consideration. Since a high school student spends so much of his time in halls, why not use them for educational purposes? Here is an idea that provides a showcase for a classroom or laboratory. In this case it is the science laboratory. Not all students take science or have any particular interest in the subject, but they should. Why not have interesting exhibits along scientific lines for students to see when they pass from class to class? If these exhibits are interesting enough (and they can be), they will create attention among the students. If visual education has a place in a well-balanced, efficient teaching program, so does this showcase. Have you ever been in the basement of Rockefeller Center where stores open on corridors? This would be a very similar thing.

Sketch 6-A: Here is a cross-section of a proposed classroom. Every architectural form has a specific purpose. For example, the interior partitions which extend out beyond the exterior walls serve as sky baffles. So do the overhangs. The high glass partitions between the classrooms eliminate any feeling of confinement in addition to serving a lighting function. The position of ventilators affords a movement of the air at the "living zone," and also provides movement at the ceiling to carry out the hot air that rises. The corridor is placed on the south to provide sufficient overhangs to keep the sun out during the teaching day; in this scheme no shades will be required, thus eliminating a nasty maintenance problem. The floor is set up above the finished grade eighteen inches or so to prevent dirt from blowing into the building; this also provides a seat around the perimeter of the building.

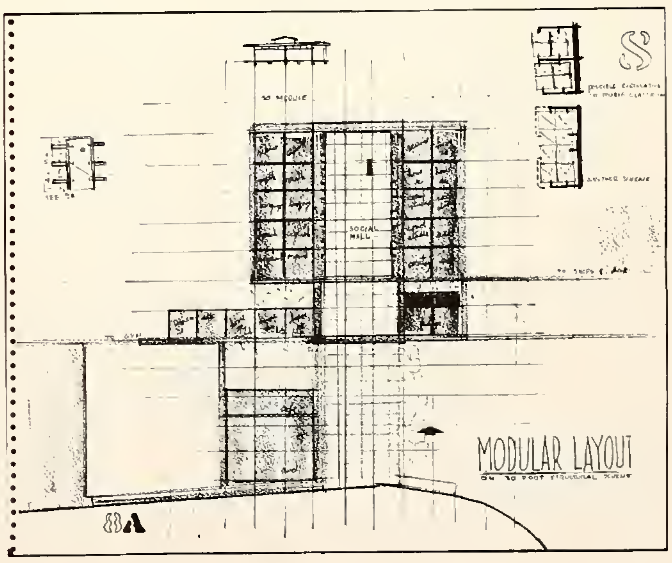


Sketch 6-B: Here is the plan of this proposed classroom. Note how the partitions are extended out beyond the exterior wall to provide sky baffles. In a well lighted classroom this is very important. It relates to the Fourth Salient Consideration. This simply means that a school child should be able to sit in any position in the room and still have proper lighting. Of course, the partition-sky baffle isn't enough. The overhangs help, but still more important in this scheme is the protection offered by the sky screen. The sky screen as shown in both sketch 6-A and in this plan is a material which admits light, but cuts down the brightness of the sky. It could be a translucent glass or even translucent draperies. Of course, this sky screen could be used over the entire wall from ceiling to floor and partition to partition. But if this were done, the student would have a "shut-in" feeling. In order to eliminate such a feeling of confinement, clear glass is provided completely around the sky screen, yet protected from the sky itself. Although the student will never actually see the sky in a seated position, he feels that he is not "closed-in." At any time he wishes, he knows that he can get up and look outdoors.

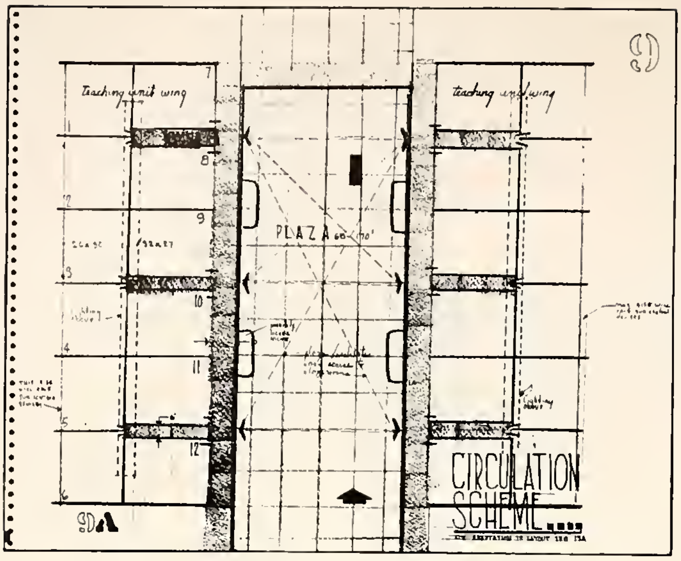


Sketch 7-A: Here is an exterior view of the classroom illustrated in sketches 6-A and 6-B. There are no frills or superfluous architecture of any type. It is an honest expression of the function; yet the architecture is simple and beautiful. Every architectural form serves a purpose. The extended partition serves as a sky baffle. The overhangs also serve as a sky baffle. The sky screen helps to produce the right quality of natural lighting. Even the extended floor slab serves as a seat. The clear glass which surrounds the sky screen eliminates any feeling of confinement. It is an example of architecture which "feels good."

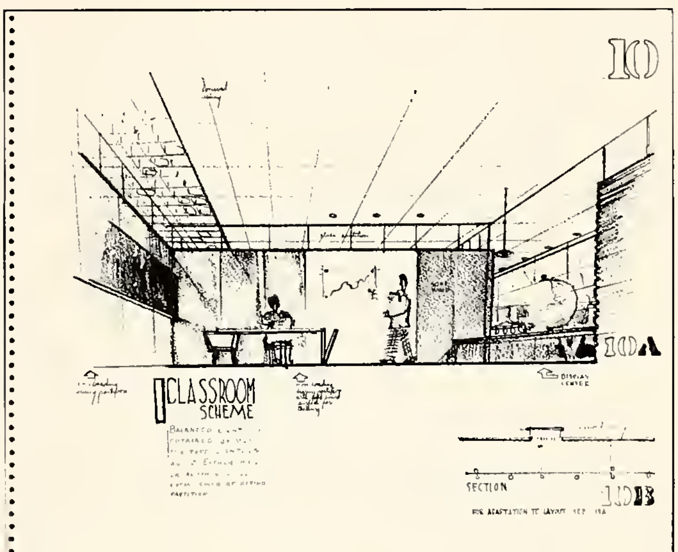
Sketch 7-B: Here is a classroom that really works for the health and comfort of the high school students—nothing false, nothing unnecessary. It is beautiful as well as functional. For more details refer to sketches 6-A and 6-B. Note the storage underneath the sky screen. Also note the floor to ceiling windows. The partition is made of soft wood so that the entire wall can be used as tackboard space. A modern teaching program with emphasis on visual aids requires a lot of space for teaching material. There is another idea brought out in this sketch. The chalkboard extends down to the floor. This is particularly useful when the teachers are drawing large maps or diagrams.



Sketch 8-A: In sketches 3-A and 3-B and the accompanying comments there is a discussion of the umbrella structural scheme. This scheme was based on a 30′ module. Modules are used to simplify construction, which in turn, naturally cuts cost. Here a layout which relates to the Norman space requirements has been made on the 30′ module. Note the PLAZA. On each side of the PLAZA there are classroom wings. Each wing has classrooms grouped back to back with corridors around the perimeter of the wings. For another scheme, and probably a better one, refer to sketch 9-A. Also note the zoning of the main areas of space. The gymnasium on the far left and the auditorium at lower center are zoned in such a way that they can have both public and student use.

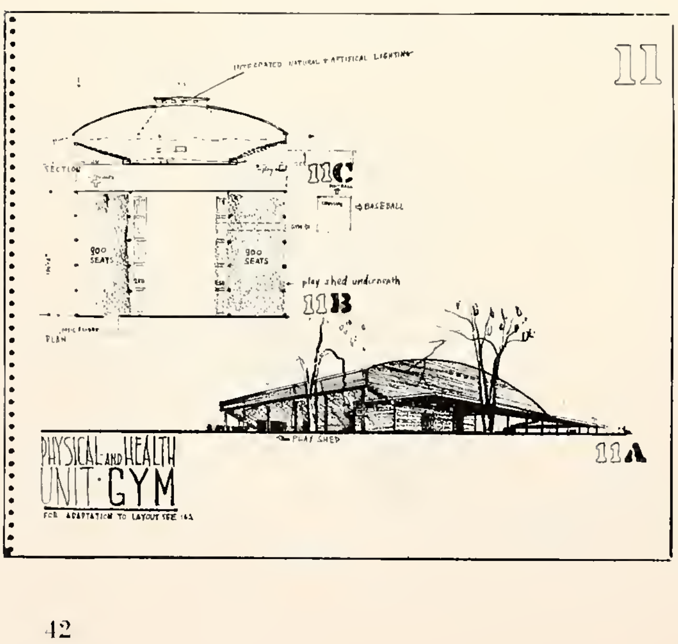


Sketch 9-A: This is a diagramatic plan of two classroom wings. Refer to sketch 8-A. This scheme allows twelve classrooms in each wing grouped back to back. There is a tremendous advantage in such grouping as far as heating is concerned. Note the plan for student traffic. Small six-foot halls, like fingers, facilitate circulation to outside classrooms. The large corridor adjacent to the PLAZA could be broken up into arrangements such as shown in sketch 1-C or sketch 5-A. Even arrangement 2-A can be worked in this scheme. Lighting is obtained by monitor type clerestory. For cross-section see sketch 10-B. This technique for lighting will furnish light in these "finger halls" as well as provide balanced lighting distribution for classrooms. Like sketch 8-A the layout has been made on a 30′ module, providing classrooms sizes 26′x30′ and 32′x27′. For other arrangements of this same type of wing, see sketches 15-A, 15-B, and 15-C.



Sketch 10-A: This is a sketch of an interior view of a typical classroom for a teaching unit wing as shown in sketch 9-A. The main corridor is on the right. The source of natural lighting which comes from the monitors is shown on the left. The plate glass showcase is on the right. There might be some who will say that the value of the exhibit area could be offset by the lack of classroom privacy. According to Superintendent Garrison there is very little activity in halls between classes and, consequently, privacy would not be a problem. This classroom is friendly, open, comfortable, and functional.

Sketch 10-B: Here is a diagram of the cross-section of the classroom. Note that the classrooms are back divided only by a partition which can be removed if the educational needs require it. The roof monitor lies over the partition and affords good lighting conditions. The corridor on the south provides sun control. For an adaptation of this scheme to an overall layout, see sketch 11-A.

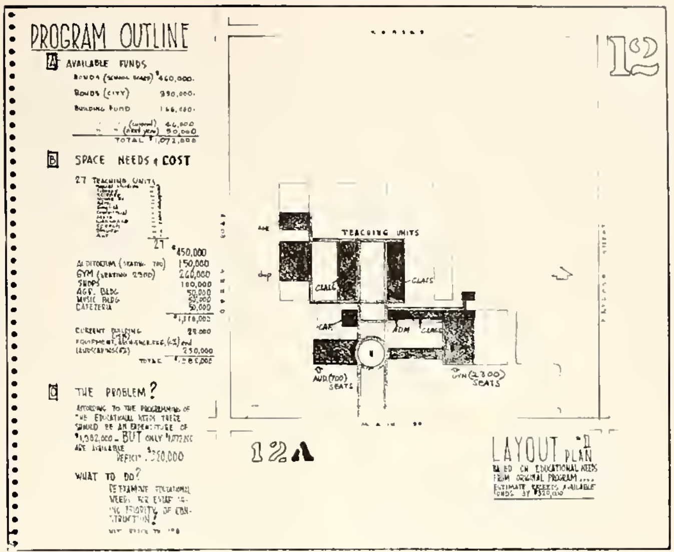


Sketch 11-A: Here is an idea for a physical and health unit. It is simple and economical. It is built like a stadium with a roof on it. Because of the honest expression it can be beautiful as well as functional. For a possible scheme relating this gymnasium to the school plant see sketch 12-A.

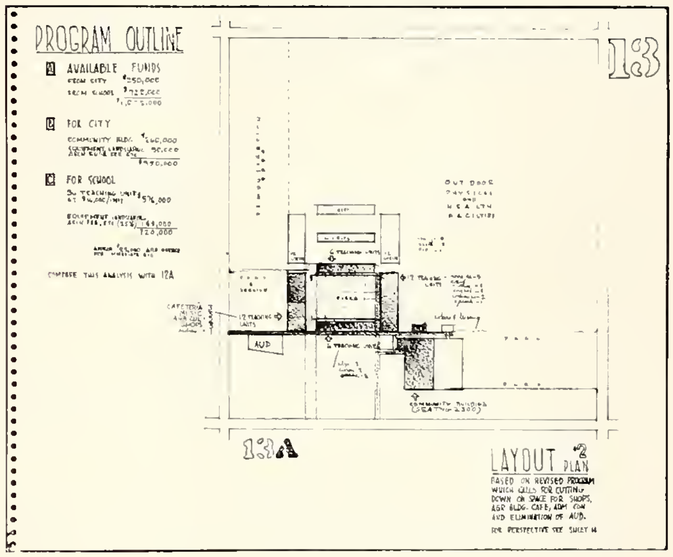
Sketch 11-B: Here is the plan for the gymnasium. A very desirable feature is the means of expansion. Expansion is made by simply adding structural bays. Such expansion provides not only additional recreational space, but also additional seats. In this case, 2300 seats are provided, 500 of which can be folded back to allow more recreational area.

Sketch 11-C: Here is a cross-section of the gymnasium. The large structural span is made by a bow-string truss. The roof line follows the top member of the truss, but there is still a 22′ clearance for basketball play. There is a monitor on the roof to provide natural lighting. By placing large spotlights in this monitor there can be integrated natural and artificial lighting. Play-sheds are provided underneath the seats. The locker and shower room is a separate building connected by a glassed-in corridor. The building design facilitates natural ventilation by having openings near the playing floor and at the spectator level. Everyone in the gymnasium can benefit by the cool prevailing breeze during hot months.

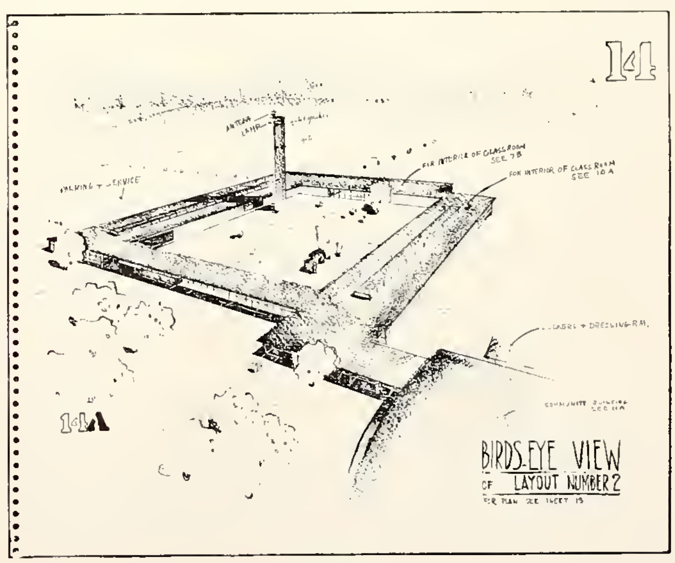
Sketch 12-A: This is a layout plan, drawn approximately to scale, for the proposed high school based on educational needs determined by interviews with the staff. It could make a beautiful plant. The zoning is good and the expansion is excellent, but unfortunately in today's construction market this scheme exceeds available funds. For the first time in this programming process there has been established a relationship of what the teachers want and what Norman's pocketbook will permit. An analysis of the needs and the available funds is made on the left of the page under "Program Outline." Note the available funds total $1,072,000 and the estimated cost of this layout comes to $1,382,000. Of course, no one can be sure of the exact cost. The construction market fluctuates. Even contractors' bids vary according to how much they want the job. Nevertheless, it is a safe bet to say that the space needs as set up in this scheme will greatly exceed available funds. What should be done? The structure is economical. About the only thing that can be done is to cut down the space. For a space cutting scheme see sketch 13-A.

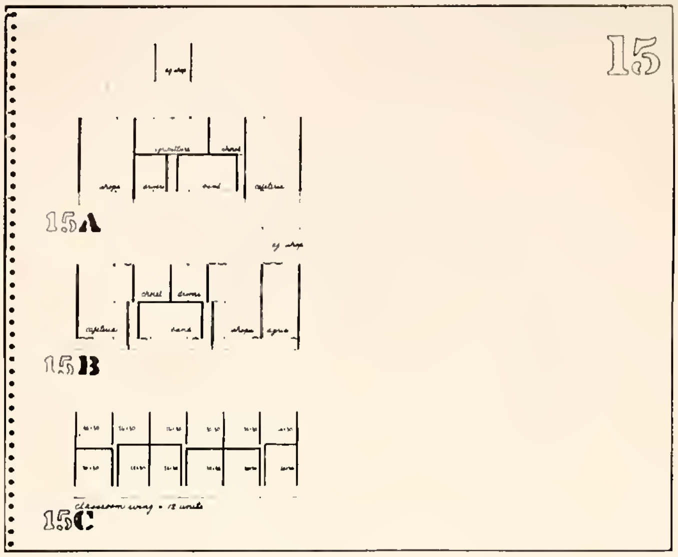


Sketch 13-A: Here is a layout which has a more happy balance between design and funds. It is a cut-down version of the scheme shown in sketch 12-A. Cutting was done on the amount of space for shops, agricultural building, cafeteria, and administration unit. The auditorium was eliminated altogether. So far as zoning is concerned, the scheme is very good. The community building can be heated separately so that it can serve the public independently of the rest of the school plant. Even the locker and dressing building is planned so that it can serve separate units of the school plant without disturbing other units. The scheme facilitates expansion so that the school can grow without growing pains. For the purpose of estimating a unit of measure was taken as a "teaching unit." In this case the teaching unit is a space 30' x 30'. In the umbrella structural scheme that space could just as well be an administrative office or a classroom. Here, for estimating purposes, the cost of the teaching unit is $16,000 which includes halls and toilets. The Program Outline on the left contains an analysis of this layout. Note there is a balance between educational needs and available funds. For a birds-eye perspective of this scheme refer to sketch 14-A.



Sketch 14-A: This sketch is a birds-eye view of layout No. 12 as shown in sketch 13-A. The four classroom wings form a large PLAZA. This tremendous paved area could serve numerous functions—outside play, social gatherings (both day and night), skating, dancing, carnivals, etc. The PLAZA is lighted from the large pylon. Although this pylon is indicated as a brick structure, it could very well be a large steel structure, or a light "antenna like" construction. The large roof mass in the lower right-hand corner is the Community Building as shown in sketch 11-A. The classroom wings with the monitor roofs are similar to ones shown in sketch 9-A.

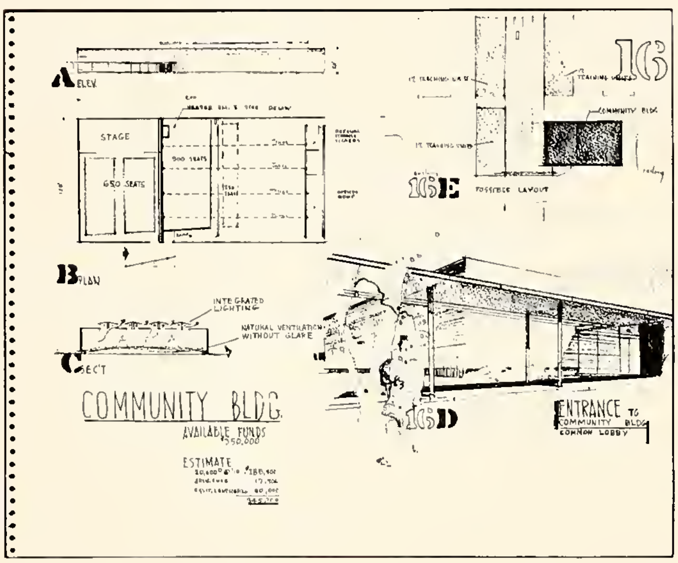




Sketch 15-A: Here is a floor plan for a typical classroom wing which might contain the shops, the agricultural unit, the music unit and the cafeteria. Refer to the classroom wing on the left in sketch 13-A. The agricultural shop is a separate unit set off from the wing since the floor level will have to be near the surface of the finished grade for driving in farm equipment.

Sketch 15-B: Here is another arrangement of the same space elements. It probably is a better one. The partitions in black are sound-proof.

Sketch 15-C: To show the complete flexibility of a typical classroom wing here is still another arrangement. This one contains twelve units. If a classroom wing is designed correctly, there will be good lighting and good ventilation regardless of the position of the partitions. Then, why can't the same type of building be used for shops, cafeterias, or home-ec units as well as for classrooms? There will be times when classrooms will have to be made into laboratories or into offices. There will be other times when shops will have to be made into classrooms or vice-versa. The ideal classroom wing will permit such changes. A changing educational program necessitates changing architectural space.



Sketch 16-A: This sketch is a front elevation of a proposed Community Building, a building combining an auditorium which has a capacity of 650 seats and a gymnasium which has a capacity of 1150 spectators. The exterior of the building is a simple masonry mass with a glassed-in lobby.

Sketch 16-B: This is a plan of the Community Building. The auditorium occupies about one-third of the building. Note that there is a common lobby for both the auditorium and gymnasium. Certainly that should bring about efficiency in operation and economy in construction.

Sketch 16-C: Here is a cross-section of the gymnasium. There is a unique technique for obtaining lighting. Lighting comes from above through the monitors. The large trusses are hidden in these monitors allowing the ceiling construction to rest on the bottom chord of the trusses. This is an efficient way of enclosing space; most buildings of this type have their roof constructions resting on the top chord of the truss, increasing the cubage. The lighting is ideal for games of all types since it comes from the top. There will be no glare. By the installation of large lights in the monitors there is integration of natural and artificial lighting. Ventilation is obtained at the floor level by openings on opposite sides of the building, and there are outlets in the monitors to let the hot air escape which rises to the ceiling.

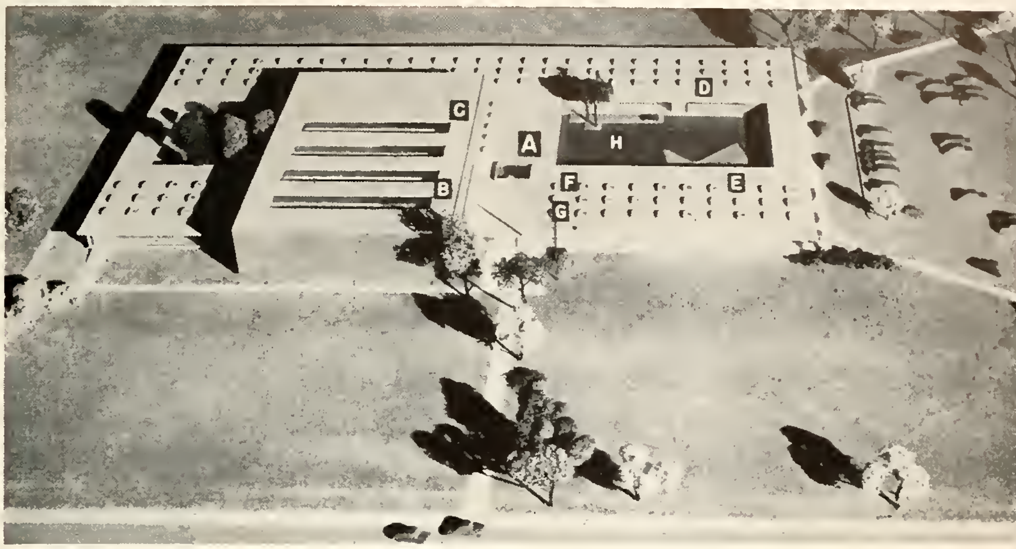
Sketch 16-D: Here is a perspective of the entrance to the Community Building. This building will be connected to other buildings of the school plant by a covered walk.

Sketch 16-E: This sketch is a possible layout which should come very close to the funds available. There are four main buildings—three double classroom-type wings as illustrated in sketches 15-A, 15-B, and 15-C, plus the Community Building as shown on this page.

centrally located space for lockers, (2) as the lobby for the Auditorium, (3) as a lobby for the Gymnasium, (4) as an extension reading room of the Library, (5) as the main Lobby of the school, and (6) as the waiting area for the Administration Unit. They reasoned the Center would actually cost very little. But this solution is relatively unimportant; it is how the solution was arrived at that is important. There are many other cases very similar to this one. For instance the Newton High School in New Jersey, designed by Architect Jay C. Van Nuys with Walter D. Cocking acting as educational consultant, was planned with consideration to the social aspect. See Case Study 26. Also refer to Case Studies 10 and 24 for a similar approach, but different solutions.

THE NEEDS AS REFLECTED IN THE CURRICULUM

The readers are no doubt asking the question, "Is not this sort of thinking overdoing the social aspect of planning? We do not want our schools to be like country clubs. They should be places of learning." That is true, and there is no doubt that this social emphasis may be too great in certain situations, but it has been stressed here because it has been so sadly neglected, particularly in our high school planning. It has been stressed too



40. Here is shown a photograph of the model of the Norman High School designed by Perkins-Will and Caudill-Rowlett-Scott. It shows that the school plant can facilitate the social aims of education if careful planning is involved. It is an attempt to make the school just as interesting to the children as the corner drug store or dive. The planners of this school hope that it will be a living room for the youth of the community. The layout is based around a student (A) which opens into a large outdoor terrace (H), flanked by cafeteria (E) and library (F). The gymnasium (B), the auditorium (C), and the administration (G), open directly into the student center.

because it relates to the Ten Imperative Needs of Youth which will be with us for some time, at least long after the present curriculum has been replaced by a better one.

When these ten imperative needs of youth are combined and translated into specific aims for education in the secondary schools, two things quickly became evident. First, the chief objectives of the old college-preparatory curriculum were not directly concerned with any of the listed needs of society, and with perhaps no more that three of the ten imperative needs of youth. Second, the aims of education in the secondary schools which conscientiously try to meet these needs do not differ in kind from those of the contemporary elementary school.

The second historical force, as mentioned before the Norman High School account, that of American pragmatism, has had its effect on the secondary schools just as it has on the elementary schools. It is true that the high schools are a little slower to reflect it, but even the slowest of these now are beginning to react. Traditional subjects are being taught in a more informal manner with more group activity and pupil-to-pupil communication, and are related to practical contemporary life. The history class might study the working of current politics, stage conventions of their own, or actually move out of the building and attend a precinct or county convention. The English class might make a propaganda analysis of leading magazines and newspapers.

In addition, secondary schools have been influenced to offer many subjects not college-preparatory in nature. These are highly experimental and are taught largely in shops and "laboratories." Some schools even go so far as to place students in actual jobs around the community for a part of their schooling. Some school systems, like that in Tyler, Texas, even operate farms of their own.

All of this adds up to an activity concept which is different from that shaping the elementary school only in its necessary added complexity.

Russell E. Wilson, one of the outstanding young school administrators of the nation seems to think along these lines, too. In his own words, he says:

> Most adults are now willing to admit that our kindergarten program is our most successful school program. Adults, either as parents or teachers, concede this. Continuing the line of thought, most of them are also willing to admit that we become more unsuccessful in our school program as the children progress from kindergarten through the twelfth grade. Perhaps, this is because we like little children. We like the characteristics that little children have. We, therefore, like to help little children solve their problems. Adults in general are then patient, kind, sympathetic, and helpful to little children. But conversely most adults do not like secondary school children and they do not like the characteristics children have. They reject all of the characteristics of secondary students connoted by the word hot rod, the use of lipstick, early dating, the showoff, the smart aleck, the jargon and slaphappy activities of secondary school youth. Adults reject these characteristics, and, therefore, these children, because they would prefer secondary age children to be as adults are, with their own adult characteristics. Adults and secondary school youth then find themselves at an Irish standoff.

The teachers in the school program seem to act as

The Diversity of School Activities

41-49. Here are a few of the many activities of education. Note the variety. Many school planners have the mistaken notion that knowledge is limited to the study of books. Nothing is farther from the truth, because knowledge is a product of experience, and comes after instead of before. As these photographs show, the new educational programs move in the direction of experiences, and books as the resources are means, not ends. For the teacher this implies that there will be much less pre-planning and more on-the-spot planning. To the school planner it means that the traditional recitation room is out—the classroom spaces are more than just cages in which to work. The well-informed school planner is intimately acquainted with these many and varied activities, and he sees that the new schools are designed to facilitate these activities efficiently and effectively in the interest of the pupil.

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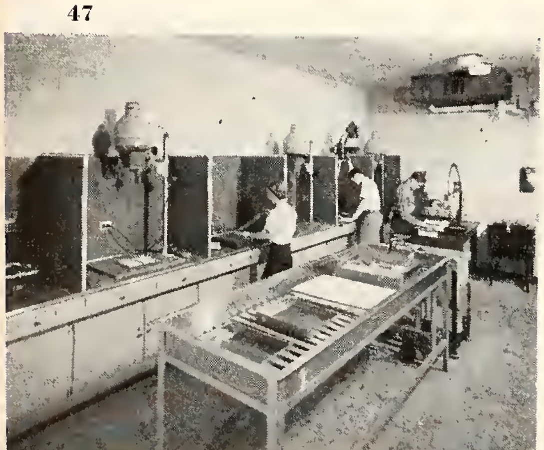

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if they expect the children to come over to their side and assume adult characteristics and then they will attempt to solve the problem of youth. This point of view leads to the conclusion that adults and educators have not really wanted to solve the problems of secondary school youth in the past and have only been willing to be interested in secondary school students if the student would come over across the fence and assume adult characteristics. This appears to account for the fact that a major portion of the time and energy of secondary teachers and principals is spent in police activity over the lives of secondary school students.

Perhaps the real problem of secondary youth could be approached by a conscious new overt act on the part of teachers and administrators concerned with secondary education. It should start with a humble admission that the greatest tribute to youth is their forebearance with adults for the atrocious crimes that we have committed against them. Then educators might be in a position to go over the barrier and to meet with youth and say to them 'We will accept you as you are with your present characteristics and further we will then try to work with you to solve your problems as they arise from your present characteristics.' In actuality this is the way that we approach the problem of little children. We do not require that the little ones act as adults but we even favor their acting as infants.

Presume for the moment that secondary school youth like to be hot rods and at the same time admit that most adults prefer them not to be hot rods. Then take the next step and presume that we are willing to accept them as hot rods and proceed to help them solve the problem of hot rods. All of us have been aware that some boys and girls will spend literally uncounted numbers of hours working on hot rods. Their devotion to the cause, their interest, the energy that they expend all testify to the fact that their interest in hot rods begins to approach the kind of things that Will James conceived in his discussion of a moral equivalent to war. Such a high degree of motivation should become a springboard for a new school program designed to solve a real problem for secondary youth.

Their interest in hot rods ought to be easily expandable into a project leading to an intense interest in the appropriate phases of mathematics, engineering, experimentation, problem solving, the making of parts, the acquisition of mechanical skills. At the same time most of these activities centered around the problems of hot rods could involve a great deal of basic reading and oral communication and mathematics and science including both chemistry and civics.

Mr. Wilson's remarks are thought-provoking. Is such an integrated program possible on the secondary level? Can the unit program of the elementary school be extended to the high school? It is quite conceivable; in fact in some degree it is already being done. Consider the next story.

MR. LUDGREN'S SCIENCE CLASS—1949

In the early part of this chapter, we were given the story of what happens in Miss Jones's third grade class during a typical day. Reading such an account places

us in a better position to approach the design of elementary classrooms. It has already been mentioned that the activity concept which shapes the elementary classrooms is prevalent in the high school classroom and laboratory as well. In order to be more specific, let us see what happens in a secondary teaching situation. This time it is Mr. Ludgren's Science class.

The fifty-seventh day of school had started! A half hour before the starting bell the "first comers" arrived in the science room, put their books on the laboratory tables and began their several activities. Nancy and Pete, students from the homeroom group, sat on stools and tried to find comfortable positions for study. Joe went to a table at the back of the room, picked up the vacuum cleaner motor he was building, dug out of a box the tools he needed, and returned to his place half-way down the room at one of the laboratory tables. John arrived carrying an old radio and asked Mr. Ludgren where he might leave it for Bill. The teacher looking around the room stacked with materials, equipment and students and seeing no free space, said, "Put it on my desk. I'll give it to Bill." Other students were coming in, leaving materials or speaking to the teacher. It was an interested and extremely alert group. One cluster of students was discussing the newest type of picture tubes for television, another the constructive used of atomic energy for the betterment of society, and a third was questioning the owner of a new camera about the lens.

Mr. Ludgren finally stepped up on the platform, made a last check of the demonstration table to see that materials he might need for the day were in place and then moved to the telephone to check with the office to be sure the audio-visual room was his for the fifth period.

As the last of the homeroom group came in and approached their places, students busy at the laboratory tables gathered their materials up and moved out of the way. Mr. Ludgren looked at the pupils trying to adjust to the poorly arranged room and wished again that science rooms might be better planned for teaching.

As the home room period began, he remembered that he had forgotten to go to the office to check on Joe's cumulative folder. Now another day would pass without his talking with this student, but he had promised to work this morning with one of the home room groups which was studying religious prejudice, and he needed to be with the group at the beginning of the period. He shouldn't miss the thinking that went into the statement of the problem or he wouldn't know where each student was in his thinking. Maybe someday there would be locked files in each room for duplicate sets of students' records.

One small home room committee pulled stools up into the little space in the front of the room between the demonstration table and the first science table. Other groups perched on laboratory tables and stools trying to form small groups. One group left the room, telling Mr. Ludgren they would work on the first landing of the stairs leading to the first floor. Again, the teacher thought of how well these boys and girls worked, but wished he might have a room that was conducive to a really excellent teaching situation, and this rigid arrangement of anchored science tables in the middle of the room was not it.

1953

Four years later on the fifty-seventh day of the school year, school started in the science room. The "first comers" of the day arrived. Mr. Ludgren smiled at them in greeting. Ben arrived carrying an old radio and, while putting it in the special storage space provided for this kind of equipment, he explained to the teacher that he thought there were some very good parts in this old set for students to use in those they were building. As the teacher chatted with Ben about the examination he was to take for a Westinghouse Scholarship, the room arrangment committee for the home room came in to arrange the furniture for the first period. Since the group was meeting in committees that morning for the first twenty minutes and then as a total group, the committee checked the lists on the bulletin board to learn the numbers in each group. They then quietly arranged the chairs and tables for committee work. Students from various science classes were working on their special projects at the science tables situated along the walls and across the back of the room—not in the middle of the room.

While the students were carrying on these activities, Mr. Ludgren made a final check of the portable demonstration unit to be sure that all the materials he needed for the day were in readiness. He made a final check of the slide projector which the men from the paper mill wanted to use as they attempted to clarify questions the class had as a result of yesterday's trip through the mill. He then went to the locked, built-in file, took out Gail's cumulative folder and put it along with her latest project on the table in the little conference room adjoining the classroom. This was the morning Gail's mother was coming in during home room period for the parent-pupil-teacher conference on work experience plans. Gail wanted to be a doctor, and Mr. Ludgren hoped she might be placed in one of the local hospitals for part of her vocational-orientation work. When this final, pre-schoolday task was completed, Mr. Ludgren looked out with satisfaction and pride at the first real laboratory-for-learning in which he had ever taught.

This is the way it happened. On the seventy-seventh day of the school year in 1949, the superintendent of schools and the high school principal had called the high school teachers together to talk with them about participating in the preparation of plans for a new high school building. The architect had attended that meeting, had talked with the teachers about functional school building planning, and the desirability of planning for flexibility, finally showing slides of various designs and room arrangements. He had asked the group

to plan, to test out their ideas in so far as they could, and to come up with the very best ideas they could for ways of developing usable classrooms. Said he, "When you've worked together on something and think you have a good idea, assume that it will work. I'll go over the scheme with you and we will see if we can develop it further together."

Committees of teachers, pupils, and parents worked in groups for ideas that would make for a really functional building. Then a representative committee from these groups sat with the architect and said, "These are some of the ideas we think it is important to give attention to in this building." Such ideas as the conference rooms and recessed screens for showing moving pictures and slides in the classroom were direct outgrowths of the work of these particular committees.

Teachers assisted one another individually and in groups. The core teachers asked representatives from the science, health, and art departments to come in to plan with their group, because many of the problems they studied used subject matter from science and health, and students often used art as a medium for communicating their ideas. This group first used the term "laboratory-for-learning" instead of "classroom." The staff liked it. It became a generally used term.

The science group began their planning by asking themselves, "What is the purpose of science in a modern program of education?" Broadly they agreed on such ideas as (1) science should help high school youth understand better the world in which they live; (2) science should help high school youth adjust more effectively to the world in which they live; and (3) science classes should develop further students' ability in the art of scientific thinking. They believed that in terms of the society in which we live, there should be science opportunities for every high school student. Those students having science talent should have opportunity to develop that talent. They agreed that students not having special talents needed much information, understanding and "know how" in the science area in order to live effectively in our society.

When these common agreements had been reached, the science staff re-examined their program, increased the offering, modified their thinking and planning in some areas, and then moved on to discuss the question, "What kinds of activities will be carried on in classrooms to develop this kind of program?" They made lists of activities. They wanted their laboratories-for-learning to make for outstanding teaching-learning situations. They wanted a combination of excellent laboratory facilities and good general teaching space so that small group study and discussion groups were possible, as well as a total study and discussion group. They wanted storage space for big projects students were working on, as well as for the usual science room equipment and apparatus. They wanted good display space and chalkboard space, space for a classroom library and facilities for protecting audio-visual materials. The lists were studied and analyzed.

The third question they then asked was, "What kind of facilities do we need to follow this kind of program and to carry on these activities?" Quickly came the unanimous plea from these teachers for flexibility in the classrooms. Said one teacher, "I'm tired of trying to carry on home rooms in these labs the way they are set up." Another protested, "It's almost impossible to teach the art of discussion with students sitting on stools behind these lab tables. Do lab tables have to be in the center of rooms? Must there be a demonstration table in the front of a room like this?"

Then followed months of concentrated work on the part of this science department staff. In their study of programs, visits to new school plants, and work with the science specialists from the nearby teachers college, they had gained many new ideas and had learned much about new techniques and materials. They had done scale drawings and had worked on arrangements until rooms were really functional laboratories in which high school youth might have rich and stimulating experiences as a result of their work in science.

The room Mr. Ludgren looked out upon as he began his day of teaching was the result of this planning and work.

This little story provided by Dr. Marcella Lawler, one of the nation's leaders for improving secondary education, has a big meaning. It means that the informal activity concept prevails in the high school—even in the science class which most of us consider must be conducted in the formal manner in which we were taught. The same concept carries through the entire curriculum of an up-to-date secondary school. Even the dead languages are made alive. Going to the high school of today is living today and working towards the future.

AN OUTLINE OF EDUCATIONAL AIMS AND THEIR ARCHITECTURAL IMPLICATIONS

It was pointed out by Neutra at the first of this chapter that architects should study the process of education. It would not be entirely improper to say that school administrators as well should study this process, particularly those whose jobs have more to do with the business of education than with education itself. This is reason enough to have teachers in on the planning of school buildings. For those school planners who do not know or do not have time to find out, the following outline of some aims and methods of education has been prepared. These have been drawn from various texts on education as well as from the wonderful pamphlet already mentioned called "Planning for American Youth"[14] which contained the Ten Imperative Needs of Youth. One column of this outline concerns Education; the other concerns the architectural implications of the educational aims or methods.

SOME AIMS AND METHODS OF EDUCATION	TRANSLATED IN TERMS OF ARCHITECTURE
• To develop in youth the social understanding and sensitivity to respect others, and to acquire ethical values and principles.	To plan school plants in terms of the social aspect by providing social courts, lounges, and assembly rooms where students can talk over their problems.
• To regard courses of study not as finished products, but as educational plans to be revised as arising needs dictate.	To design classrooms for flexibility and to plan structures which can be changed economically to conform with changes in education.
• To teach children to work together and instill in them a spirit of cooperation.	To design classroom units to permit children to work in small groups and to design equipment which can be adapted to small group work.
• To cultivate creative interests and abilities in children, with consideration given to the fact that every type of activity has creative possibilities.	To provide facilities where children can experiment in all phases of education, but particularly in art, dancing, crafts, and music, with consideration that activities will take place in ordinary classrooms in the lower grades and perhaps special classrooms in the upper grades.
• To develop skills in children through meaningful situations close to their daily activities.	To make provisions for the use of gardens in connection with mathematical problems in the lower grades, for reference materials such as newspapers and magazines in connection with reading skills, and for places where students can gather in developing speaking skills, etc.
• To consider the physical and emotional growth of children as well as their mental growth, and to afford situations where the life and work of the school contribute to such.	To design the school plant to serve the physical needs by having ample indoor and outdoor play space and equipment, and to serve the emotional needs by providing a friendly and beautiful place for children to go to school.
• To give youth understanding and appreciation of the way of democracy, and to afford them an opportunity for practicing this kind of life at school every day.	To plan the school plant to serve democratic activities with provisions for meeting places for elected governmental groups, bulletin boards for local news on governmental activities in community living, and assembly space for large groups.
• To encourage active participation by the children in most learning situations.	To recognize that the formal type of classroom characterized by the "sit and learn" method has been replaced by the informal classroom designed for the "learn by doing" method.
• To develop in youth effective methods of thinking.	To provide the kind of architecture that is conducive to thinking—a stimulating school plant for learning, a cheerful and quiet place for school life.
• To make subject-matter more interesting, with relationship to problems of youth and modern civilization.	To build flexible classrooms and laboratories, to permit building large models (for instance, model grocery stores or villages) for learning situations, and to provide tools and equipment to make them.
• To encourage the collection and use of original material produced by the children.	To provide space in classrooms and laboratories for aquariums, nature collections, clippings, and pictures, with special consideration given to possibilities of school museums.
• To stimulate children's participation in most forms of the arts.	To design classrooms in which singing and dancing, creative art, and dramatics can take place by using movable furniture and equipment.
• To provide curricular enrichments such as student government activities, scout work, academic clubs, journalism projects, and athletic opportunities for all students.	To provide small conference rooms, large playrooms, gymnasiums, auditoriums, classrooms and clubrooms which can be used as meeting places.
• To take advantage of any up-to-date teaching method and devices such as audio-visual aids.	To make radios, television sets, charts, maps and phonographs available to the teachers and provide ample storage for these audio-visual aids.

SOME AIMS AND METHODS OF EDUCATION	TRANSLATED IN TERMS OF ARCHITECTURE
● To place emphasis not on subject matter alone, but on real life situations.	To plan the school as a youth community, with not only space to teach subject material, but also space for social and recreational activities.
● Not to be guided solely by fixed schedule of classes, and to make allowance for learning activities that might occur during classwork or even outside school hours.	To plan the school plant so that a noisy learning situation will not interfere with quiet study.
● To give adults opportunity for continuous education.	To include in secondary schools facilities for night classes and to design the lighting and mechanical work with this in mind.
● To recognize the physical development of school children and make the provisions for it in the educational program.	To provide health clinics with necessary storage for records and medical supplies, and to provide physical education facilities.
● To consider community needs.	To plan the school plant for use by the community after school hours, with special consideration given to the recreational grounds, the auditorium, and the gymnasium.
● To give special consideration to handicapped children for their all-around development.	To make provision in the school plant for special facilities such as sight-saving classrooms, ramps for children in wheel chairs, and classrooms with special hearing facilities—without setting up an obvious segregation.
● To give paramount consideration to the health and comfort of the children.	To design comfortable classrooms and laboratories with emphasis on proper lighting, adequate heating, adequate ventilation, and sound conditioning, without sacrificing any qualities that go to make up a colorful and stimulating environment.
● To offer children opportunities for exploration of crafts and industrial arts.	To provide shop facilities in the classrooms of the lower grades and in special laboratories in the upper grades.
● To guide older children in developing salable skills.	To provide facilities in the secondary schools for developing skills in the trades, in typing, shorthand, drafting, and the like.
● To teach children of all ages an understanding of the significance of the family to the individual and society.	To provide facilities in the school plant which will encourage families to participate in school activities (P.T.A.) and to have facilities for such courses as home making, family living, and marriage education.
● To give the youth the knowledge to purchase and use goods and services intelligently.	To make available space for carrying out classroom activities based on everyday living in the lower grades and to have space for such courses as distributive education in the upper grades.
● To provide opportunities for understanding the methods of science, scientific facts, and the influence of science on the world and man.	To design science laboratories based on conceptions of teaching much broader than mere demonstration by providing facilities that will encourage active participation and exploration by the students; and to provide these laboratories with bulletin boards and reference materials necessary for the students to understand the reason and impacts of scientific development.
● To develop appreciation for beauty in literature, art, music, and nature.	To make provisions not only for facilities to study literature, art, music, and nature, but also for such facilities as places for recitals, libraries, exhibit halls, and museums, and to make the building beautiful.
● To provide guidance for wise use of leisure time.	To make provision in the school plant for carrying out the activities of hobby and recreational groups.
● To consider each child as an individual.	In all grades provide nooks in classrooms for individual instruction and guidance, and in the upper grades provide added facilities of rooms for full time counselors.

A COMMON APPROACH TO THE DESIGN OF BOTH ELEMENTARY SCHOOLS AND SECONDARY SCHOOLS

This discussion has suggested certain basic similarities between elementary and secondary schools. Are these similarities real? A casual look at elementary and secondary school plants around the country would more than hint that they are not, but what these plants really say is that a great many people (most of them not trained to know) have for a long time assumed the two levels had no really common ground. Educators who have studied the question think that there is such a common ground and that it should be recognized and acted upon. As one very well-received and highly noted source[15] puts it:

> "Historically the elementary school is the American *common school*. Only in the present century has the theory that the secondary school should provide an equalized educational opportunity for all been widely accepted as a basis for action. Until this occurred, the secondary school was separated from the elementary by a fundamental difference in philosophy. At present the pressing problem of the secondary school is precisely in this change of philosophy, for its purpose is to provide an appropriate education for all youth, an education centered in the role of youth, as citizens, homemakers, and workers.
>
> This problem should bring the two schools together. In brief, here is a common dominating purpose operating for the twelve years of elementary and secondary education. Secondary schools are moving to become a part of the *common school* system of America in fact as well as theory. If this is to be accomplished, the gap between elementary and secondary schools should be eliminated altogether. Elementary school graduations, secondary school selection of students, marked differences in curriculum organization between the last grade of the elementary school and the first year of high school, major breaks in the sequence of the curriculum, separate standards of preparation and remuneration for teachers—all these differentiating factors should be eliminated and the elementary and secondary school drawn together in the closest possible relationship, forming a twelve-year continuous program of education. Elementary school and secondary school should be but convenient units for administration and organization of the program."

If there is a basic similarity between elementary and secondary schools, and if they are in fact moving closer together in their aims and general approach, it stands to reason that the functional, living architecture which has demonstrated its value to education on the elementary school level should be equally valuable on the high school level—that there can and should be a common approach to the design of both schools. This is not an untried notion: several high schools have been built around the country from just such an approach.

The common design approach rests on certain factors that are fixed in both kinds of schools and thus provides the design frames for both. First, both are occupied by children with the same environmental needs differentiated chiefly by a greater sophistication in the emotional needs of the older group. The discussions of environment and architecture in chapters one and three apply equally in principle to both groups. Second, both groups of students are being educated to meet the same sets of needs of society and of youth. The differences are not in kind but in complexity, with the secondary school requiring a closer attention to the needs of society and a greater variety of facilities and equipment. Third, both are structures which will see many partial and specific changes in use throughout their spans of usefulness. Both must be flexible and in the same basic ways.

The differences between elementary and secondary schools from a planning point of view lie within the limits of these dominating fixed factors. There are obvious differences, for example, in curricula, and these must be taken into account. But both are basically the same kind of curriculum, and the architectural features designed for either must meet such similar requirements of flexibility that this variable factor becomes a smaller, however important, problem. There are differences in teaching methods, too, but not differences divergent in kind which would affect a planning approach. The most formalized specific class in a high school can be taught in a comfortable and cheerful room, and the furniture can be lined up in rows without being fastened down to make the room less usable for anything else. And the methods of teaching of specialized shop courses differ in kind in no essential way from much of the teaching in the elementary school's self-contained classrooms. Similarly the equipment in high schools is more of a problem to house than is that in elementary schools, but this problem does not call for a different planning approach.

A planning approach which begins with a study of the real needs of children in an ever-changing educational environment and then provides flexible answers to these needs and to specific variable questions can produce a good secondary school just as well as it can a good elementary school.

CASE STUDIES WHICH ARE RELATED TO CHAPTER 2

No. Problem:

2 Can boiler rooms have educational functions?

5 How can the homemaking unit be designed with consideration given to outdoor living and dining?

10 How can school corridors be planned for use other than just walking?

20 How can a school be designed for effective community use?

24 Can corridors be made to serve purposes other than walking space?

26 Can corridor space be used for purposes other than circulation?

28 When "committee" or "activity" space is specified to facilitate the educational program, what is the best way to work it into the classroom layout?

44 Can outside space be arranged to facilitate classroom activities?

50 Can classroom storage be housed to advantage in movable cabinets?

52 Can a large school be planned with an intimate, friendly character?

54 What facilities are necessary for outdoor teaching?

65 How can we improve the appearance and scale, and encourage multi-purpose use of playrooms?

66 How close can we come to ultimate flexibility in practice?

67 Can dining and reading spaces be combined?

69 What is a practical method of audio-visual blackout for standard classrooms?

70 How can appearance and scale of double-loaded corridors be improved?

79 Can corridors be eliminated?

81 What type of classroom will best suit small group activities?

84 Can stages have maximum flexibility to conform to the high school program?

85 What is one way to darken a classroom for the projection of pictures with the least amount of effort and time?

89 Can the pupil have a part in planning and building the school?

91 How can teaching devices be grouped for effective use?

CHAPTER 3 ENVIRONMENT AND THE SCHOOL PLANT

Up to now the discussion has been about the pupil and the process of education in which he is involved. The next consideration of this approach to planning schools is the physical enclosure of the pupils and the process. One of the most important jobs that the architect has is the design of this enclosure—or envelope—a building cover which will provide physiological and psychological comfort to the pupil as well as afford educational efficiency. This chapter will concern the design of the envelope as an instrument of pupil comfort.

THE ENVELOPE—A COMFORT PROVIDER

What is the basic reason we have schoolhouses? Obviously a schoolhouse is a house for school. Its purpose is primarily to *house* the pupils and the process of education. The verb "to house" has such meanings as "to place under cover," "to overspread," or "to protect from exposure," but, of course, the schoolhouse is more than a shelter; it must serve the emotional needs as well as the physical, just as a house must. Even when men lived in caves they painted pictures on the walls to make their surroundings a little bit more than mere shelter. So during this discussion we must remember that shelter is only a part of architecture, not architecture itself. But the consideration of shelter is very important, particularly in a schoolhouse, because it is essential to comfort, and comfort is important to learning.

The educating process could very well be conducted in the middle of a pasture at times when the weather happens to be just right, and no envelope would be needed. In certain sections of the world the only protection needed to carry on a class program during most of the year would be just a large umbrella covering the class to offer protection from the sun and rain. Here a schoolhouse would consist of a roof and that is about all. In other sections of the country because of the cold and sometimes because of the extreme heat and wind, we would have to add walls.

And that is really the only reason for them. Sometimes we would build these walls of glass, sometimes of masonry. But it stands to reason that there are many good ways of building walls other than the conventional ones which result in our punching a masonry or wood surface full of holes and putting windows in them. When we realize the basic functions of walls, maybe some day we can design them to serve these functions honestly and efficiently. When we think of the envelope, and we usually do so in terms of walls and roofs, we should not think their purpose is to keep out the forces of nature. Our concept should be much broader. The true basic purpose of the envelope is to neutralize the forces of nature so that they will be in equilibrium with the counteracting forces of man's system of heating, cooling, seeing, and hearing, as discussed in Chapter 1.

To illustrate, suppose we consider the situation mentioned previously—a class being held in the middle of a pasture. If the air temperature is just right, the wind just right, the humidity just right, and the lighting just right because of a completely over-cast sky, then, from the standpoint of comfort, there is no need for the envelope. But if the sun comes out, the pupil has too much light for close work; he needs some sort of a shelter to permit only *part* of the light that nature affords. In this case the purpose of the shelter is to neutralize the light, to use only what is needed for the comfort of the pupil. Now let us assume that by the installation of a roof the forces of natural light are brought into equilibrium with the resisting forces of the pupil. The teaching situation in the middle of this pasture is the same as it was except now we have a roof. Everything again is set in the interest of pupil comfort. But if the wind increases, this movement of air throws the equilibrium of comfort out of balance, and we must have some sort of barrier or filter which will slow down the air movement to what was there in the first place. So we build a little wall, not necessarily a solid one, to go with the roof, and our envelope is beginning to look more like a building. This kind of reasoning could be carried on through consideration of air temperature and radiation. The envelope, then, is not for the purpose of keeping out the forces of nature—it is to modify them. The schoolhouse should not fight the forces of nature; it should work with nature to provide comfort.

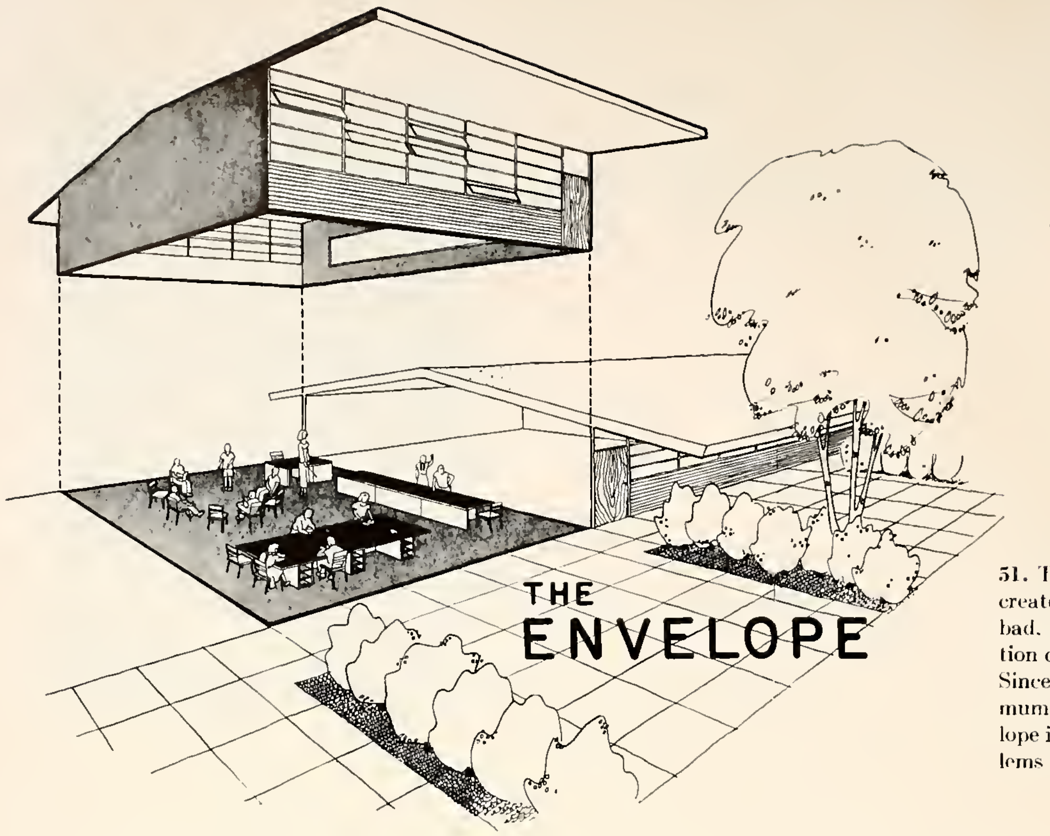
And, as an allied consideration, the schoolhouse should not be divorced from nature; it should har-

50. The second leg of the tripod concerns the environment. A listing of such factors as adequate lighting, sound conditioning, and proper ventilation and heating determines the length of this leg.

monize with and take advantage of all that nature has to offer in the way of beautiful surroundings. That is why sometimes glass walls are better than brick ones. For a classroom unit which takes advantage of economical, but very desirable space afforded by nature, refer to Case Study 44. Here is a case where the teaching space (usually thought of in terms of interior classrooms) was more than doubled by the provision of a few outside walls and roofs to protect the pupil from the sun, rain, and wind.

Let us take another learning situation—physical education. Most active sports such as football, track, basketball, swimming, soccer and baseball should be participated in outdoors if the weather is just right. In some parts of the country they can be played outdoors most of the year. In other parts, because of extreme climatic conditions, certain modifications must be made; for example, in Evanston, Illinois, a large shell was constructed over a playfield so that track, baseball, football, and other outdoor games could be played even in the worst weather. The building is heated, but only to the point of active comfort afforded by nature on a mild day. Exterior swimming pools have been covered for the same reason, and there are some instances where these envelopes are such that they can be completely removed during the summer months. For an adaptation see Case Study 63. When college football took over Saturday afternoons and forced the high schools to reschedule on Friday nights, when most of the working people could attend, we modified the forces of nature and lighted the football fields. We left all other conditions the same, however, and now there is talk that some day our football and baseball fields will be covered with large plastic envelopes which will keep out the rain, snow, wind, and extreme cold—and guarantee attendance *and* profits, if you please.

But let us get down to more immediately practical cases. During the programming stage of planning new schools for Blackwell, Oklahoma, in 1948, the school board, the superintendent, and their architects met with a P.T.A. group to "determine some of the problems of the school plant." When asked if she knew of any particular problems, one lady rose to her feet and made a statement about like this: "I have three boys in school, very active boys. For the past six weeks they have been coming home from school so full of vinegar that I have had no control over them whatsoever. I have talked to other parents, and I was happy to learn that my boys are not the only wild and wooly ones in school. We believe we have found out the trouble. For the past six weeks because of the rain, mud, and wind, the children in our schools have not had the opportunity of playing outdoors. Apparently their energies are dammed up and when they come home from school, the dam breaks on us, as parents. Now Mr. Architect, I do not know if you can do anything about it, but it would be very wonderful if our new school could have some place, paved perhaps, under cover and protected from the wind in which the children can play during cold, windy, rainy weather." She went on to say, "The temperature is cold, but with proper wraps all of the children can play outdoors, provided they have a protection from the cold north winds." This lady not only presented a problem but suggested a solution, one which was carried out to the letter in the form of a playshed which not only proved to be a very useful part



51. The envelope which covers the class creates its own environment—good or bad. Its shape, openings, and orientation determine comfort within its shell. Since comfort is so necessary to maximum learning, the design of the envelope is one of the most important problems confronting school planners.

of the building, but actually enhanced the beauty. See photograph 143. In addition, this solution which stemmed from a problem involving the climate, actually proved to be a very great educational asset; the principal of the school said that the playshed is used for everything from teaching classes to having assemblies.

THE ENVELOPE OF THE CLASSROOM AND LABORATORY

Since the classroom and the laboratory are the most generally used spaces in the school plant, let us consider now the envelope which houses the activities in those spaces. When we place this envelope, consisting of walls and ceilings, over these activities, we create a modified climate with environments good or bad depending upon just how we put together the envelope. We create a thermal environment, a light environment, and a color environment, and even a sound environment because a person can detect a smaller change in the sound frequency of a source in a room than he can in the open air. So by putting walls and ceilings over a teaching situation, we are creating a modified climate for our youngsters. That is a big responsibility for any school planner particularly when he knows that the climate produced by this envelope affects the health and learning of the pupil. Perhaps the most critical step in the entire planning process is that of translating the desire for the proper environment into envelopes that actually provide that environment. The most painstaking preparations and the best intentions are valueless if the resultant schools do not function to fulfil these intentions. And the unhappy fact is that they far too often do not. This is not mere argumentation; it is a conclusion reached after numerous and careful tests made of a wide variety of envelopes and building products. The basic reason for this all too common failure of the completed schools is a too easy acceptance on the part of planners of conventional shapes, for example, the unilaterally lighted classroom. It is hoped that the material presented in this chapter will show that there is no one solution for construction of the envelope; that there are many, many shapes and patterns which can be combined to make up a wall, a floor, or a ceiling; and that these have infinite numbers of possible arrangements to form the classroom envelope. But the school planner cannot help but be troubled at the difficulty of selecting from this vast array of combinations the one that will provide the best environment, particularly when he considers that each solution is dependent upon purely local conditions including geographic area, the location, size and contours of the site, the weather conditions such as the direction of the prevailing breeze, the location and proximity of surrounding buildings, fences, trees, the availability of certain materials, budget limitations, and a host of other conditioning factors. The problem sounds difficult; all complex problems do, but generally the large, complex problem can be broken down into smaller and more simple ones.

Accordingly, let us peel away all of the variables brought about by the locality and get down to the core of the problem—consideration of the geometry of the classroom as related to such factors as lighting, air flow, and sound. We need to know the answers to such questions as these. How do ceiling heights affect lighting, air flow, and sound? What does the depth of the classroom do? What effects do overhangs have? Where should windows be located and how large should they be? Where is the best place to install acoustical tile? And do elements of landscaping affect lighting, air flow, and sound?

THE TEXAS ENGINEERING EXPERIMENT STATION PROJECT

In 1949 the Texas Engineering Experiment Station started an architectural research project to try to find answers to such questions. Most of the data in this chapter have been gleaned from the research reports stemming from this project (listed in the bibliography as numbers 16, 17, 18, 19, 20, 21, and 22). A research team, consisting of physicists, architects, a landscape architect, and an aeronautical engineer, found a good number of answers about air flow and natural illumination. The project started out as correlated research in which the essential environmental factors were to be considered simultaneously, but because of limited time, only natural lighting and natural ventilation were considered in the first phase of this long range project. But the project was significant, and unique, in that at least two environmental factors were considered simultaneously; here for the first time a research organization got down to the business of finding something out about lighting without completely ignoring ventilation. There is evidence that good natural lighting in classrooms is sometimes obtained at the expense of natural ventilation, and vice versa. So by reporting the research of the Texas Engineering Experiment Station in this publication, it is hoped that school planners will see the value of a *simultaneous* approach to the design of the classroom and laboratory envelope, with consideration given not only to natural lighting and natural ventilation but to sound conditioning, heating, color, and artificial lighting as well. If we do not consider these factors as inseparable components of a single inclusive problem when we design the envelope of the school plant, then we put ourselves in the same position as John Saxes's "Six Blind Men of Indostan" who "went to see the elephant though all of them were blind," and concluded separately that the elephant looked like a wall, a spear, a snake, a tree, a fan, and a rope. Saxes's point was that "though each was partly in the right, all were in the wrong!" for lack of a total concept. For this next discussion we will open our eyes to see at least two environmental factors at once—natural lighting and natural ventilation as related to various geometric shapes of classrooms.

OPENINGS TO LET LIGHT AND AIR INTO THE CLASSROOMS

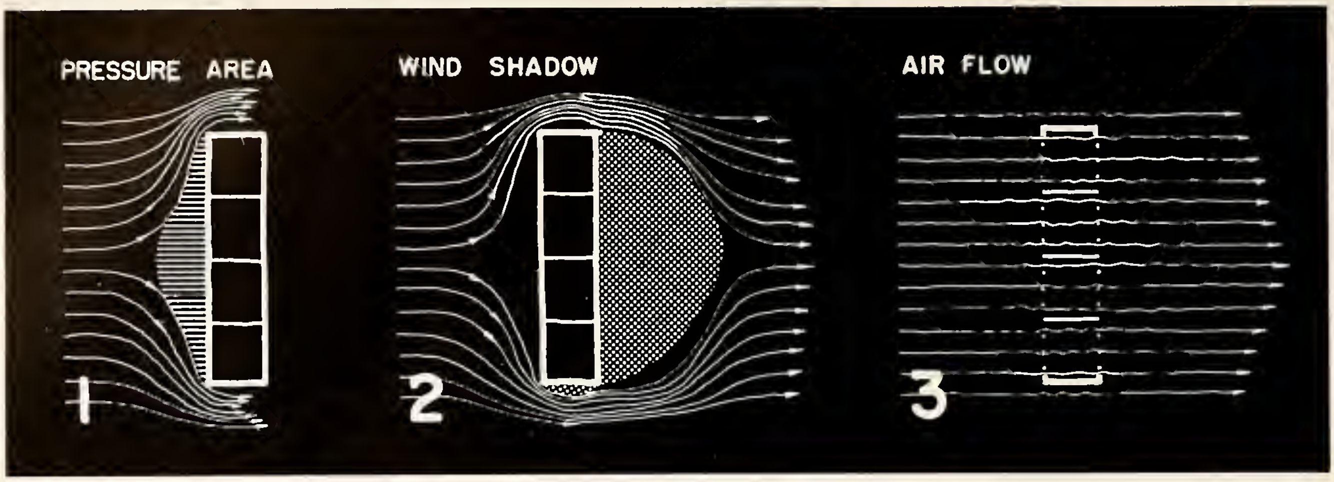
If there must be walls to keep out the cold and rain in this envelope, then there must be openings in them to let in light and air. The questions confronting the architect, therefore, are how large these openings should be and where they should be located. At least partial answers to these questions may be found in the discussion that follows, which was taken from the research report of the Texas Engineering Experiment Station concerning the geometry of classrooms as related to natural lighting and natural ventilation.[22]

First let us consider how openings affect air flow. For years architects have assumed that the best way to make a room comfortable is to orient the room perpendicular to the prevailing breeze and open it from floor to ceiling and as wide as possible in order to scoop the breeze into the room. Thousands of rooms in schools, homes, hospitals, and clinics have been designed on this premise. In a few cases, consideration was given to the fact that in order for air to flow through the room, there must be openings to let the air out as well as openings to let it in.

In these cases, some of the rooms were cross ventilated by a few louvers on the opposite wall or transoms over the doors. Results from experimentation proved that the "scooping-in" method is very ineffective as far as comforting air movement is concerned. Test results show it is very difficult to secure fast moving air across classrooms by use of extremely large inlet openings unless very large outlets are also provided. In fact, if maximum speeds within a classroom are desirable, the outlet openings should be larger than the inlets. Like the flow of water, the flow of air will dam up when blocked by an object such as a wall and will exert pressure on that wall. If the wall is punctured with an opening, the air will flow through this opening at a relatively high speed. In a large reservoir, there is relatively no movement in the lake portion, but there is a great movement at the spillway. In a classroom, if the fenestration facing the wind is completely opened, then there will be a "dam" on the opposite wall, resulting in very little air movement within the classroom but considerable movement just on the other side.

These conclusions are substantiated by tests run on four different bilateral situations with varying opposite fenestrations. The first situation has a 2-ft. 6-in. inlet opening with no outlet opening. Of course, tests show that there is no air movement within the classroom except some near the window that may be caused by gusts. The second situation is exactly the same as the first except that a high 2-ft. outlet was provided. The results of the test indicate that the speed of the air near the inlet just inside the classroom is 62 per cent of the speed of the outside air and that it gradually decreases

How the Wind Envelops a Classroom Wing



52. These three sketches show how the wind envelops a classroom wing and sets up relatively low and high pressure areas which in turn may facilitate air movement within the classrooms. For example, in Sketch 1 the wind flowing against a building wing causes a pressure area on the windward side of the building. But when the wind flows over and around the building as in Sketch 2, it sets up a relatively low pressure area on the leeward side. This area is sometimes called a wind shadow. Now if openings were placed in the walls adjacent to the pressure area as well as in the walls adjacent to the wind shadows, the air would "push" itself into the classrooms on the pressure side and "pull" itself out on the wind shadow side, since air will flow from a high pressure area to a low pressure area. These sketches were adapted from the American Institute of Architects pamphlet BT1-3, "Classroom Comfort through Natural Ventilation," by Caudill and Reed.

at positions across the classroom. The third situation which provided a 1-ft. outlet, shows that at the point near the inlet in the classroom the air flow is actually higher than the wind blowing against the building. The speed is 110 per cent of the outside air speed with 61 per cent at mid-point and 25 per cent near the opposite wall. The fourth situation is exactly the same as the other, except a 6-ft. outlet is provided. In this case, the air flow at the point near the inlet is 127 per cent of the outside speed and dwindles off at a point near the opposite wall to 30 per cent of the outside air flowing against the building. See Illustration 66.

We can conclude, therefore, that (1) very large inlet openings and very small outlet openings will produce very slow air movement within a classroom, (2) in situations where the inlet remains the same size while the size of the outlet is increased, the air flow within the classroom will increase accordingly, (3) and if air movement is to be achieved in a classroom, there must be openings to let the air out as well as openings to let the air in. These are pretty good reasons to think that we should add "bilaterally ventilated" to our vocabulary as well as "bilaterally lighted."

Now let us find out what happens to natural lighting under the same set of circumstances. The first situation shown in Illustration 94 has to do with light distribution when light of an overcast sky enters the room only from one side. Tests proved that there is a 2.6 to 1 drop in the distribution. In the second situation, where the main source of light is supplemented by 2-ft. windows on the opposite wall, the distribution improves to a ratio of 2 to 1. Also, there exists a 14 per cent increase in intensity at the center of the room at desk height. Light is additive; if it comes from two sides, the intensity at a point within the room is simply the amount of light from one side added to the amount of light from the other. When the supplementary light source is increased to 4 ft., the distribution across the room is improved, being 1.5 to 1, and the intensity at the center of the room is increased 33 per cent over the unilateral situation. Tests on the 6-ft. supplementary opening show that the distribution is 1.3 to 1 with an intensity increase at the center of the room of 51 per cent. If there are any doubts of the advantages of bilaterally lighted classrooms over unilaterally lighted (or ventilated) classrooms, these figures should eliminate them.

From these studies we can conclude (first) that in classrooms and laboratories where there is a main source of light, as a supplementary source is increased, the intensity through the room will increase accordingly and the diversity will decrease, and (second) that if light comes from two sides of a classroom, the intensity at a point within the room is the amount of light from one side plus the amount from the other. In other words, since light is additive we can improve the distribution within a classroom by introducing light from more than one side. Accordingly, ideal distribution of lighting for classroom activities might be like that found in the shade of a large tree. Certainly such a situation would be desirable because of the high illumination, and, if

there were no large bright objects such as a white building or terrace in view, the situation would approach perfection for quality as well as quantity.

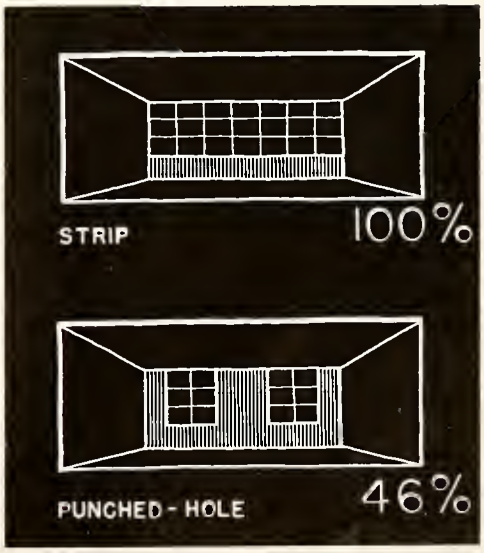
BASES FOR DETERMINING THE HEIGHT OF CEILINGS

Many school planners apparently fail to see the great savings that can result from lower ceilings, for high ceilings in classrooms seem to be the rule, not the exception. Years ago when formal education and formal seating was the thing, it was decided that light should come only from one side of the classroom, over the left shoulder of the pupils. Of course, the one out of every seven pupils who was left-handed missed out on this lighting provision, but he should not have been left-handed in the first place. In addition to the unilateral requirement, it was also decided that ceiling heights should be not less than one-half the depth of the classroom to assure lighting near the back wall. But this still put the little guy near the windowless wall pretty much in the dark, whether he was left-handed or not. And just as bad, this minimum ceiling height ruling produced rooms out of human scale, and teaching spaces that were expensive because of their large volume. This will be discussed more in detail in the next chapter. The discussion here will show how ceilings can be brought down to more desirable and economical heights.

First consider the effects upon air flow by the ceiling heights. It is true there is some movement of air caused by thermal currents, air flow caused by temperature differences. Hot air rises, but it does not rise fast enough to be felt on a hot day. Since even the tallest industrial chimneys, up to 10 stories in height, are normally proportioned to give a flue-case velocity of less than a slight breeze of four miles an hour, certainly the few feet of difference in ceiling heights of one-story classrooms would not affect the movement of air within the classroom area to any great extent. It can be said, therefore, that if the effects of the slightest breeze were superimposed over the effects of thermal currents in one story buildings, the effects of the breeze could completely offset the effects of the thermal currents. Some people argue in favor of high ceilings that ceilings radiate heat and the higher the ceiling, theoretically, the less radiation effect hot ceilings will have on the occupants of the classrooms. But again, experience shows that if the effects of the breeze flowing through a classroom were superimposed upon the effects of radiation from the ordinary classroom ceiling, the air flow in most cases would predominate. Moreover, tests conducted on prototypal classroom shapes, reported later in this chapter, indicate that if because of the character of the inlet, the air flow is directed toward the ceiling, the pattern will follow the ceiling shape unless there is a sharp break in the ceiling profile. Therefore, it can be said that ceiling heights, as far as air flow is concerned, are relatively unimportant. (See Illustration 67.) Tests conducted on an 8-ft. ceiling situation gave results identical to those conducted on a 12-ft. ceiling classroom. In each case, the inlet openings were similarly located, and the air flow was the same. In regard to natural lighting, this is another story.

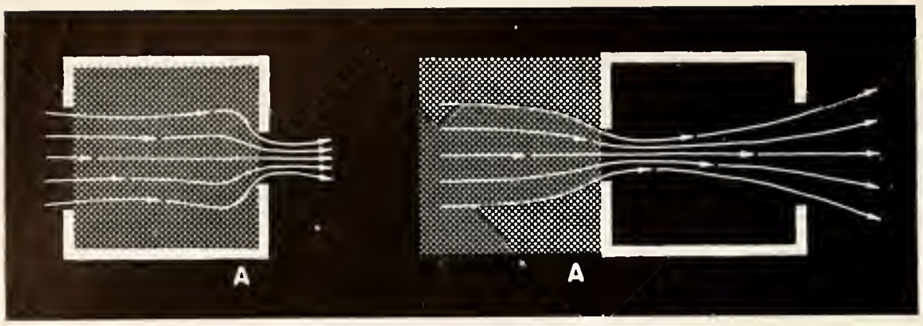
Now let us consider ceiling heights and their effects on natural lighting. It is pretty obvious that if light comes into one or more sides of a classroom, the higher the ceiling (of course, if the window head is at the ceiling) the higher the resulting intensity of illumination. But the question before us is how much higher. A further study of Illustration 67 will provide the answer to that question.

It should be pointed out that a study of either ceiling heights or room depths, without eventual relation to



Punched-Hole Windows vs. Strip Windows

53. Why have strip windows in classrooms? For one thing, they produce more natural light than do the so-called punched-hole windows. These sketches indicate the results of a test conducted to determine the comparative lighting performance. It was found that in a unilaterally lighted classroom at a point near the windowless wall the punched-hole arrangement produced only 46 per cent of the light found in the same relative position in the continuous strip window arrangement.



Air Flow Speeds in Interior Spaces

54. One popular misconception of the proper sizing of openings is the practice of putting extremely large openings toward the breeze, with the idea of scooping the air into the room, and a strip of small openings on the opposite side of the room to allow for cross ventilation. Actually, the reverse situation would be better from the standpoint of cooling, because maximum air speeds within a building are acquired when the outlet is larger than the inlet. This phenomenon can be compared to the movement of lake water through a spillway. The water always rushes out of the lake, but the lake itself moves hardly at all. In the upper diagram, the "lake" occurs inside the room because of the relative size of the inlet and outlet, and the point of highest speed or the "spillway" occurs just outside the room. In order to have the maximum air speed within the room where it will do the most good, we should reverse the situation and put the smaller opening on the side facing the wind. The lower diagram shows what happens. Here the "lake" is on the outside and the "spillway" is on the inside.

each other, is meaningless. All else being equal, the proportion of ceiling height to room depth is what counts. Consider the proportion of one to two, for instance. For all practical purposes, a room with a 12-ft. ceiling height and a 24-ft. depth will have the same level of illumination as a room with a 14-ft. ceiling height and a 28-ft. depth under the same conditions.

A study of the results of tests will show how the natural illumination within a classroom varies with a linear variation in the ceiling height. This, of course, concerns classrooms with a fixed depth. In the Illustration 95, the two classrooms, one with an 8-foot ceiling and the other with a 12-foot ceiling, each have a 28-foot depth. A study of these diagrams will show that when the ceiling of the unilateral lighted classroom is dropped from 12 feet to 8 feet, there is a 44 per cent drop in illumination at a point one-sixth of the classroom width from the windowless wall. This bears out the premise that the higher the ceiling, the higher the illumination. It also proves that in unilateral situations, the ceilings should be very high in order to have light on the wall away from the windows. But even the 12-foot ceiling does not provide adequate light in the case of the 28-foot classroom depth, and the distribution is very poor. Now refer to the same diagram and see the results with a bilaterally lighted classroom. Generally, the results are similar, but the variations are not so marked. When the ceiling is lowered from 12 to 8 feet, there is a 35.5 per cent drop (in comparison to 44 per cent in the case of the unilateral situation) at the low point, which occurs in the middle of the classroom. The diversity of illumination across the classroom, too, is much less in the case of the bilateral classroom, particularly the 8-ft. ceiling classrooms. There is a four to one drop for the unilateral classroom, and only 1.75 to one for the bilateral classroom.

It can be concluded, therefore, that in unilaterally lighted classrooms the lower the ceiling, the lower the illumination and the higher the diversity across the classrooms; and that in bilaterally lighted classrooms the same conditions prevail but to a less marked degree. Remember this applies when the window head is at the ceiling.

THE DEPTH—AN IMPORTANT DIMENSION FOR NATURAL LIGHTING

The old saying that goes "You can't tell the depth of the well by the length of the handle on the pump" does not quite hold true of classroom depths and adequate lighting. We can be certain that if the drop in illumination across a unilaterally lighted classroom is not very great, it is a certainty that the classroom is not very deep. Unilaterally lighted classrooms simply cannot be very deep and have high intensities near the windowless wall without having excessively high ceilings. It should be repeated here again that the depth of the classroom cannot be considered independently of the ceiling height; it is the proportion of the room that counts.

In order to find out something about classroom depths, tests were conducted on three unilaterally

Air Flow Patterns of Interior Spaces

55. What path will the air follow within a room? A study of these five diagrams will give us a fairly good answer to this question. Let us trace the flow of air step by step. Consider Diagram 1 as a floor plan of a simple room provided with openings on opposite sides to let the air out as well as in. In this case the air flow pattern is what would be expected, a straight path between the two openings. Now let us see what the change in the pattern will be when the outlet opening is moved to an adjoining wall. Refer to Diagram 2. Suprisingly, the path across the room is very similar to the first situation, and the air flow does not "short circuit" between the two openings. In this case the inside pattern of the air was determined before the air got into the classroom. Look at Diagram 3. The air piles up against the wall, which has its inlet opening symmetrically located, and flows toward the outlet with equal force components, and it flows into the room in a direction parallel with the wind. The wind has enough inertia to carry itself across the room without making a change in direction until it reaches the opposite wall. Now look at Diagram 4. The inlet opening has been moved; this throws the equal force components off balance, and since the air flowing alongside the large wall area creates a stronger force component, the air will flow into the room in the general direction of the stronger force. Note again that the location of the outlet does not control the airflow pattern. It generally flows across the room in the same direction as it enters before finding its way to the outlet. Now take a look at the final diagram. It is a situation just like Diagram 4 except that a modification has been made of the inlet opening. It now has been changed from a simple opening to a vertical vane type opening like a door or a casement window. This modification completely changes the interior path of the air. The strong force component, which was set up in Number 4, has been eliminated by the vertical vane and the opposing force component comes into full play and controls the direction in which the air enters the room. This primer on air flow pattern may be summed up as follows: (1) the inlet openings, like the nozzles on a water hose, control the direction in which the air will flow across the room, and (2) they do so regardless of the location of the outlet openings.

lighted classrooms, each having the same ceiling height (in this case, 12 ft.), but each having different depths—24 ft., 28 ft., and 32 ft. The results (see Illustration 96) show that as the classroom is made deeper, the intensity throughout becomes less. For example, the classroom 28 ft. deep has 18 per cent less light at a point near the windowless wall than has the 24-ft. classroom at the same relative position. There is a 28 per cent drop in the case of the 32-ft. classroom. The drop in intensities would be even greater if points recorded had been kept the same distance from the windowless wall instead of at a proportional distance.

The distribution drop across the classroom also increases as the room becomes deeper. At a 24-foot depth, the diversity is 2.6 to one; at a 32-foot depth, it is three to one. Bilaterally lighted classrooms were not tested, because experience indicates that results would be about the same as for unilateral classrooms, except the diversity would not be so great, and the intensities would not diminish so greatly with increase in depth. To sum up,

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Sun Control

56-60. There are many ways to control sun. It can be done by providing overhangs (56) or by louvers (57), or by interior sun baffles (60), or simply by translucent drapes (59), or by the use of directional glass blocks (58). Of course, there are many other ways, but these shown here at least prove that no one solution answers all problems of locality and orientation. Recent attempts have been made not only to keep the sun out of the classroom, but also to keep the sky from view in order to eliminate excessive brightness.

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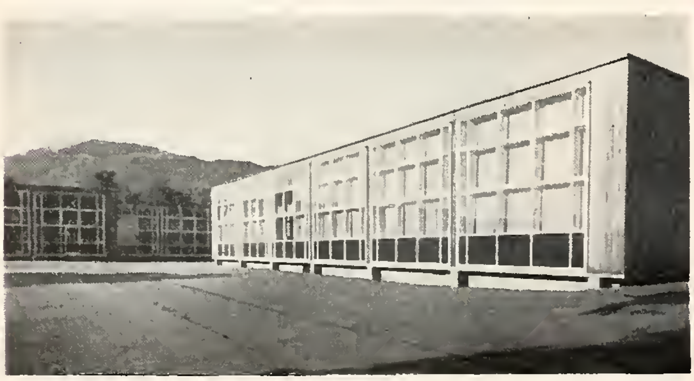

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Breeze Control

61-65. There are also many ways to control the breeze. Such controls relate to speeds and patterns. The first thing that school planners must look out for is the spacing of buildings—to see that one wing does not block the breeze from another. Here is a carefully planned layout in respect to such natural ventilation considerations (61). But when such wings have proper spacing and orientation, there must be openings properly sized (62) to let in the breeze. Sometimes openings for light and air are separated, as in the case of this Texas school (63), which has strip windows to let the air into the classrooms and top lighting for adequate natural illumination. In order for air to flow through interior spaces, special care must be given to openings in interior partitions (64). There are other ways to provide inlets and outlets than with conventional windows. The bottom photograph (65) is an outlet arrangement having fixed glass for light for horizontal wood doors for air outlet. Again these are a few of many solutions.

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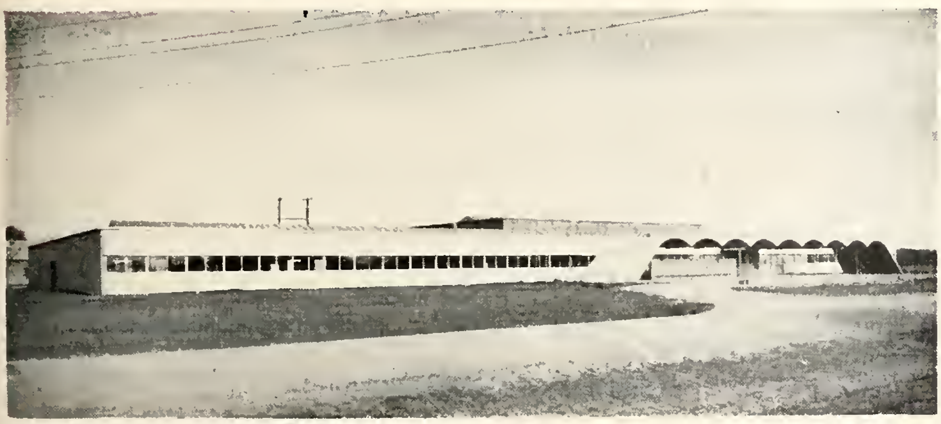

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we can say that the effect of making the classroom deeper while holding the ceiling height constant is similar to the effect of lowering the ceiling while holding the depth constant. We can conclude, too, that for both unilateral and bilateral situations, as the room becomes deeper, the illumination decreases and the diversity across the room increases, but in the bilateral case it is to a much lesser degree.

MULTILATERAL SCHEMES

There are endless possible multilateral lighting schemes (for example, classrooms with top light) whereby high intensities and low diversities may be achieved with classrooms both deep and low. The results of these tests present a strong case for multilaterally lighted classrooms over unilaterally lighted classrooms. By cutting the ceiling height of a classroom down from 12 ft. to 8 ft. and using overhead lighting, the construction costs may be reduced considerably. Here we should mention the industrial type of building with its saw-tooth roofs, monitors, and skylights. The lighting and ventilation requirements of industrial shops and laboratories are not unlike those of classrooms, and it is surprising that only very recently have school buildings benefitted from techniques developed by architects of industrial buildings. School architects can benefit tremendously by studying factory lighting and ventilation.

DEPTH OF CLASSROOMS AND AIR FLOW

Now what does the depth of a classroom do to air flow? It has very little effect on either the pattern or the speed, but it does affect the number of air changes. For example, if two classrooms have identical window intakes, the same exhaust openings, the same height of ceiling, and the same length, but one has twice the depth of the other, the larger classroom, having twice the volume, will have only half the number of air changes from air flow of a given speed. Yet the linear air flow (the breeze you can feel), which affects comfort, would be the same.

The advertised figures relative to air changes sound impressive, and when thought of in terms of winter ventilation, they are significant, but when considered in terms of hot-month ventilation, they mean very little. A classroom can have many air changes per minute, but if the children are not in the flow of air, they will still be uncomfortably warm. It is air flow, not the number of air changes that counts. In lighting, the depth of the classroom is very important; in hot-month ventilation it is insignificant.

From these observations we can conclude that the depth of the classroom has very little, if any, effect on the flow of air. We can also conclude, for what it is worth (and in terms of hot-month comfort it means very little) that if all other dimensions are equal, the number of air changes is inversely proportional to the depth of the classroom.

CODES THAT REGULATE CEILING HEIGHTS AND DEPTHS

A word about state and city codes may be appropriate here. Some codes say that ceilings should be not less than such-and-such distance from the floor, but it is ridiculous to make laws regulating ceiling heights without mentioning depth. A ceiling may work fairly satisfactorily in a unilaterally lighted classroom only 18 ft. deep, but the lighting might be very poor in a unilaterally lighted classroom 30 ft. deep. The old rule of thumb (which incidentally found its way into many codes) that the height of a classroom should not be less than one-half its depth really is a pretty good one—but only for unilateral classrooms. In multilateral situations, ceiling heights may have very little effect on lighting. We have many cases where classrooms 30 ft. square with top lighting and only 8-ft. ceilings have excellent distribution and high intensities. Why should we have codes to regulate ceiling heights? They do not make sense when we think of the endless multilateral lighting possibilities.

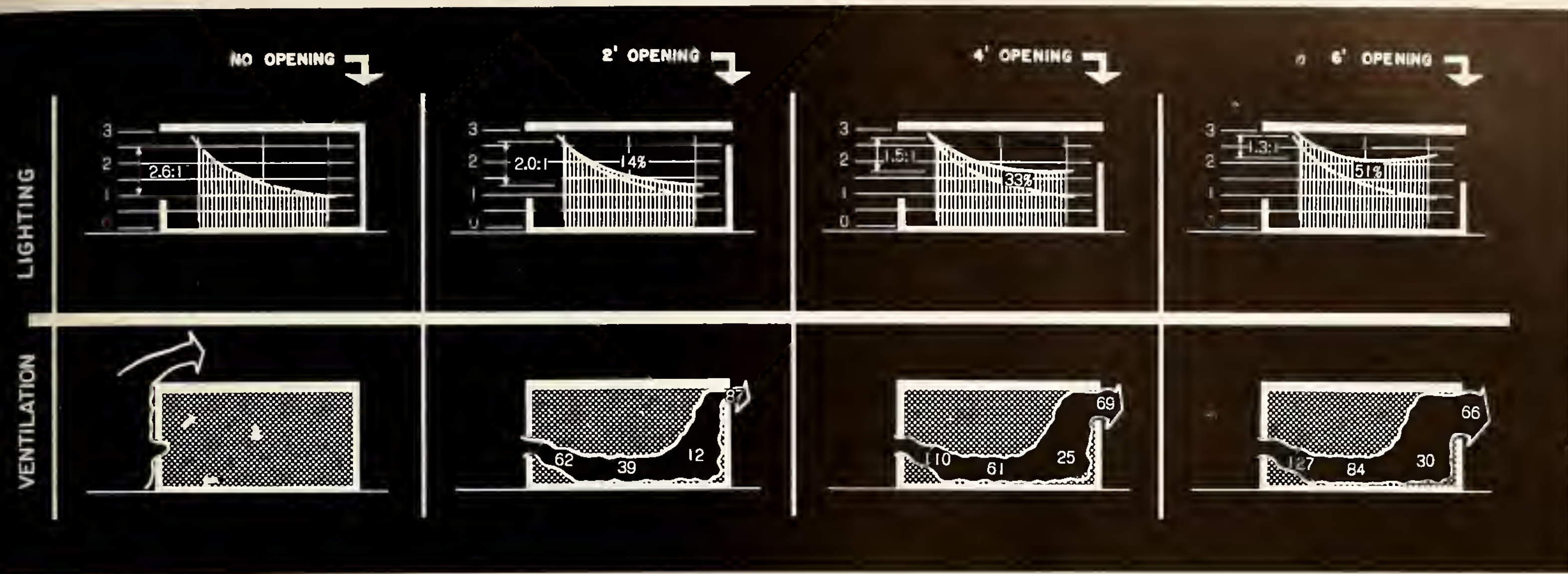
Can something be done about these codes? At the time of this writing, school planners all over the United States are trying to erase them from the law books. This campaign for more freedom of planning is well justified, because if we are to achieve good schools at prices we can afford, we need all the advantages that we can get—particularly the advantages offered by low cubage. Case Study 44 tells how one group of planners went about producing evidence for a modification of an obsolete code.

WHY THE OVERHANG?

Antony Part, that stimulating English observer mentioned previously in this book, most vividly described a dilemma of U. S. schoolhouses when he said, "It is a mystery to me why you install large classroom windows to get natural light, and then pull down the shades and turn on the switch to get artificial light." And that is just exactly what the teachers usually do. If their classrooms are on the east or south, the first thing that they do early in the morning when the sun is shining in is to pull down the shades and turn on the lights, and they usually leave them that way all day. The lighting situation on the west side is a little better, because here there is no direct sunlight until afternoon, and the lights are turned on only half the day. Yet this does not make west classrooms desirable, because the sun gives off heat as well as light. Pull down the shades and the heat is still in the classroom. So it seems that both the heat problem and the light problem demand some sort of sun control, but in this discussion we are concerned only with light.

If close work is essential in classrooms, and apparent-

How Openings Affect Light and Air



66. These diagrams show how light and air behave under similar circumstances. The first column on the left represents a classroom situation with openings only on one side. The second column represents the same situation except that a 2-ft. opening has been added on the wall opposite the original windows. The third and fourth columns show the supplementary opening enlarged to 4 ft. and 6 ft., respectively. The results of the lighting tests shown here as well as others to follow are for an overcast sky and were based on empty 24-ft. width classrooms with 12-ft. ceilings having reflectivity of 85 per cent, walls 60 per cent, and floors 40 per cent. The unit of measure is represented by the value "1" and designates the amount of light measured at a point one-sixth the distance of the classroom depth from the back wall. The results of the ventilation tests are based on "simple" openings—openings without any deflecting vanes—and the numerals represent percentages of outside air speed. A close study of these diagrams will show that if a classroom has large windows on one side as the main source of light, and small windows on the other side as a supplementary light source, the intensity throughout the room increases and the diversity decreases when the area of the supplementary light source is increased. It will also show that if there is to be a movement of air across the classroom, there must be outlet openings as well as inlets; and that with a given area of inlet openings, as the area of the outlet openings is increased, the air movement through the room is increased. In short, if we want an evenly distributed, high level of illumination and a substantial air flow we must provide at least two different openings, approaching the same size, in each classroom.

ly it is, then sun rays simply should not be allowed to fall on the work area. The sun rays may be kept out by conventional shades, venetian blinds, louvers, glass blocks, or overhangs. These controls should be fixed. Classrooms carefully engineered for natural lighting will completely lose design balance if one shade is pulled, and teachers have enough jobs to do without having to act as illuminating engineers. For the most part, every school architect should make a sun analysis of every school he designs and provide fixed sun controls to exclude the blistering sun rays from the classrooms. This does not mean that all sun rays should be excluded from the classroom. No sun is needed for proper lighting but for the sake of cheerfulness, a little sun is a great asset. It is difficult to say exactly where one stops and the other begins, but a good architect should be able to find the answer. For example, Architect John Reid designed a classroom which excluded the sun from the classroom proper, but allowed it to enter the adjoining informal activity area.

A word might be added concerning overhangs as brightness control devices. It takes a very long overhang (or "hangover" as one school board member so picturesquely called it) to shield the classroom from the brightness of the sky. The average 4- or 5-ft. overhang does little good as a sky shield unless it is supplemented with background elements such as mountains, trees, or other buildings. Some planners have said, "Although these overhangs on the north windows do not shut out the entire sky, they do protect the children from the high sky which causes the most glare." This is not exactly the truth. In fact, on perfectly clear days, brightness readings on the north sky sometimes show that the area near the horizon is considerably brighter

than the high sky. Perhaps dust is the reason. Since on perfectly overcast days the reverse may hold true, excessive brightness may be expected in any area of the sky. For this reason, overhangs, unless they are extremely large, are ineffective as sky shields except when they are supplemented by landscaping or other outside elements of shade.

Architects who use overhangs for sun control and rain control are often criticized. They are asked, "Why have large windows to bring light into the classroom: then keep the light out with overhangs?" At first glance it appears that such criticisms may have merit. In unilaterally lighted classrooms, tests prove that overhangs do cut out a great amount of light. But, surprisingly, the tests show that as the overhang is increased, the lighting near the window decreases at a much greater rate than the lighting near the windowless wall. Therefore the distribution is generally improved.

Consider first a unilateral situation. Tests were conducted on a 30-ft. by 24-ft. by 12-ft. classroom, and after readings were made, a 2-ft. overhang was installed to see how it would affect the light intensity and distribution. (See Illustration 74.) Results show that the 2-ft. overhang caused a 14 per cent drop near the window and a 7.5 per cent drop near the opposite wall. The distribution curve straightened out somewhat, the diversity of the classroom with no overhang being 2.6 to one in comparison with 2.4 to one for the classroom with the 2-ft. overhang. Tests were then conducted on the classroom with a 4-ft., then a 6-ft. overhang. The 4-ft. overhang caused a 24 per cent drop near the windows and a 15 per cent drop near the opposite wall, and it improved the distribution to 2.3 to one. The 6-ft. overhang caused a 39 per cent drop near the window and a 22 per cent drop near the opposite wall. This last and largest overhang caused a considerable improvement in light distribution over the first classroom (with no overhang), the first room having a 2.6 to one drop and the last a two to one drop.

What does this mean? It simply means that overhangs in unilaterally-lighted classrooms cut down the intensities, but at the same time, improve the distribution. At this writing preliminary investigations show that under certain conditions the ground reflectivity can actually be brighter than the sky, which perhaps partially explains this condition.

Now consider a bilateral situation and examine the lower horizontal column of the diagrams shown in Illustration 74. A close study of the results of tests on bilaterally lighted classrooms will show that the overhang is an excellent lighting control device as well as a control for the sun. For example, it was found that the bilaterally lighted classroom with the 6-ft. overhangs had more than twice as much light at the lowest point (center of the room) than the unilateral classroom with the 6-foot overhang had at *its* lowest point (near the wall). The lighting for the bilateral classroom proved to be much more evenly distributed than for the unilateral room. Both unilateral and bilateral follow the general rule that as the overhang increases, the intensities decrease but the distribution is improved. In the bilateral situation, this is good; in the unilateral case, the intensity drop sometimes is dangerously low. In short, overhangs may actually improve over-all lighting in bilaterally lighted classrooms, but are questionable in unilateral situations.

OVERHANGS AND LIGHT

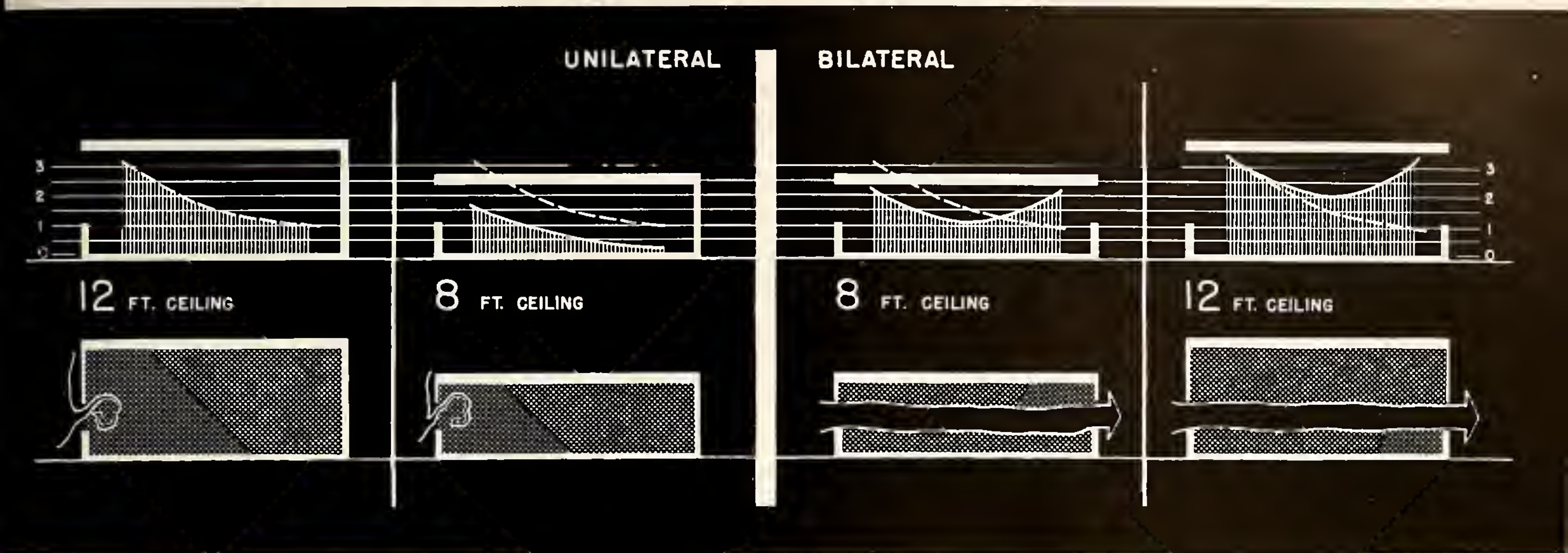
According to present-day opinions on minimum intensities for classrooms (differing from 10 to 50 foot-candles), children seated next to windows have light to spare. Intensities on a cloudy day (say a 1000 foot-lambert sky) range from 150 to 250 foot-candles near the windows, greatly exceeding the minimum. In nearly every case of bilaterally lighted rooms, the lighting distribution curve rises sharply near windows, but placement of overhangs outside these walls can flatten the curve considerably.

Overhangs can be effective light distribution control devices for those school planners who believe that classrooms should have evenly distributed light so that no matter where the school child sits he gets the same amount of light afforded to all his classmates.

As a summary of the effects of overhangs on natural lighting, what do we have? For one thing we can say that as the overhang is increased the intensities near the windows decrease at a much greater rate than the intensities in the interior of the classroom, and therefore overhangs cut down the intensities but improve the distribution. Another conclusion that we can make in studying these diagrams is that bilaterally lighted classrooms with overhangs have much greater intensities and have better distribution than unilaterally lighted classrooms of the same proportions with or without overhangs. We can add that since bilateral situations produce such high intensities, the disadvantages the overhang offers by cutting down intensities at interior points may be offset by the advantage of improved distribution. And a final conclusion might be that since unilateral situations produce such comparatively low intensities at the interior side, the advantage of the improved distribution achieved by the overhangs may be offset by the accompanying decrease of intensities to levels below the recommended minimum. This last conclusion may be an argument in favor of directional glass blocks and light-reflecting louvers for use in the unilaterally lighted classroom. But the other three conclusions give a very strong case for the use of overhangs for the improvement of lighting conditions.

OVERHANGS AND AIR

But what do overhangs do to air flow? Tests have proved that they sometimes hinder and sometimes facilitate natural ventilation. There are cases where over-



67. Here is a graphic analysis which shows the lighting and ventilation performance between a unilateral and a bilateral classroom situation. The top horizontal column concerns natural lighting, and the bottom concerns natural ventilation. Consider the first, a typical 12-ft. ceiling unilaterally-lighted classroom. Note the lighting curve—very high near the windows, but the very low near the opposite wall. If the ceiling is lowered to 8 ft., as in the second sketch, the curve remains about the same, but the intensities are much lower. Too low. But the bilateral situation is quite different. The 8-ft. ceiling classroom has higher minimum illumination and better distribution than does the 12-ft. unilateral situation. And of course the 12-ft. bilateral situation is even better. Now consider airflow. Since air cannot flow through a room unless there are openings to let it out as well as openings to let it in, a unilaterally ventilated room simply does not offer cross ventilation; however, there is some movement caused by gusts. The bilateral situation is different, of course, because there are openings on two sides. As these sketches show, the ceiling heights do not materially affect the pattern of the airflow. One may conclude from a study of these sketches that classrooms designed for bilateral lighting and ventilation may have relatively low ceilings (which unquestionably will result in construction savings).

hangs actually scoop air into openings; there are other instances where overhangs direct air to the top of the room. For example, tests conducted on the typical glass block fenestration, that is an exterior wall with 3 ft. of brick, 3 ft. of vision strip, (casement windows in this case) and 6 ft. of glass block, showed that sun hood overhangs actually directed the air over the heads of the children, since the brick wall created an upward force component. The overhang eliminated any downward force component which might have been caused by air flowing down the glass block panel. In an attempt to find ways of creating a downward interior flow pattern, researchers cut a slot in the overhang which resulted in a very effective downward flow of air to the living zone of the children.

One of the most common cross sections used in multilaterally lighted schools is the one which has the open corridor on one side with clerestory windows above the corridor roof and large windows on the opposite wall. When the corridor side is oriented toward the prevailing breeze, one might expect that the air would flow through the high windows into the classroom. Sometimes it does, but there are many cases in which the overhang covering the corridor diverts the air flow over the building and leaves the high windows in a wind shadow. In some cases, the air actually flows out of instead of into the windows. Research will have to be carried to a much more advanced stage before such effects can be calculated, so much depends on the size of the overhang in relation to the size of the clerestory window. Even the size of the facia and the slope of the overhang may influence the flow of air.

From this discussion we can conclude that (1) the addition or subtraction of an overhang is capable of completely changing the manner in which the wind will flow through a simple opening, and that (2) such factors as the slope, depth, and thickness of the overhang covering outside corridors will determine whether or not air will flow through clerestory windows situated above outside corridors.

Are overhangs then worthwhile? If properly used, yes, overhangs can be extremely beneficial to both natural lighting and natural ventilation.

WHAT KINDS OF WINDOWS ARE NEEDED?

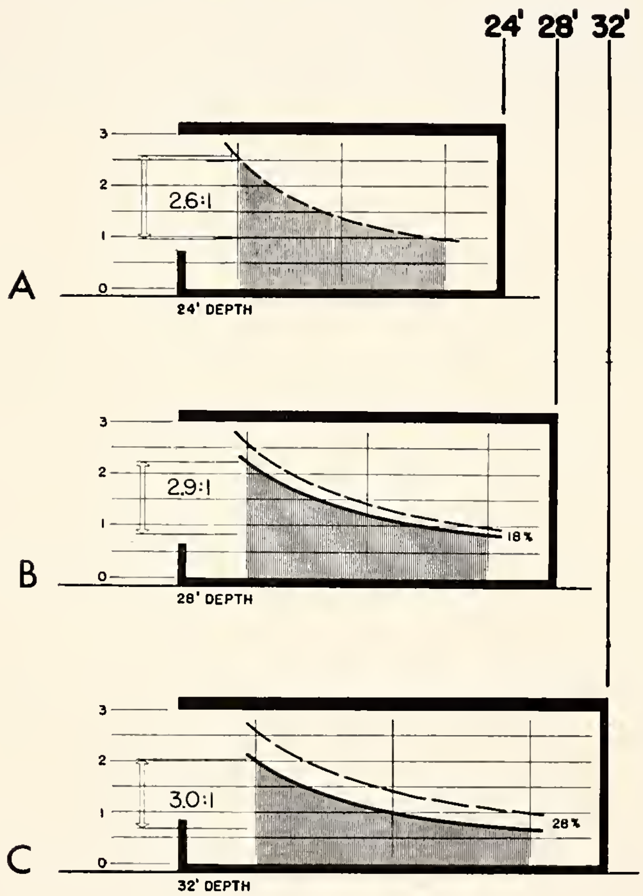
We know the window too well. It has been with us so long that we take it for granted. A window, we think, is something that must be in every building, and there is nothing that we can do about it. It lets in the air as well as the light. But does it do a good job? Is the typical window really functional? Not necessarily. First let us consider the function of letting light in. Let us go back to the "classroom in the middle of the pasture" story. The only reason that glass is needed is as a wind break or a thermal barrier; the light is controlled by the roof and comes in better without glass, for even the clearest plate glass cuts out 10 per cent of the light. In these terms, the so-called window, installed in the middle of a solid wall, may not be what we want.

Now let us consider the function of air flow. We say that we want windows to let in the air. But why the windows? Why not let air in and out of the ceilings or even through a floor which might be raised for the purpose? See Case Study 27 for a case where the space underneath the floor was used as an air duct with grills on each end. Why not separate air and light? Do they have to be combined? These remarks are not meant to run down stock windows (manufacturers have been making great progress with them these last few years), but they are included here to show that "windows" are not the only solutions for the problems of lighting and ventilation.

As a matter of fact, the window as a device to let light into the classroom seems to be satisfactory. Certainly great improvements have been made to increase their efficiency. The large mullions which reduce the amount of light entering the classroom (and also create a glare source) have nearly disappeared. The panes are generally becoming larger and, in recent schools, there are fewer light-reducing muntins. The glass panes themselves are apparently doing a good job. The common window glass transmits up to 90 per cent of the light. Screens cut down some light, but most school planners seem to think that screens can be eliminated in classrooms. Of course, if classrooms are used at night, or the students eat in the classrooms, screens may be quite necessary because of the insect problem.

For the purpose of natural ventilation windows are less satisfactory than for lighting. For example, there has recently been completed a very fine rural school building for which the architects had every opportunity to take advantage of natural ventilation. And they did so. They placed the rows of classrooms perpendicular to the prevailing breezes. They designed ample openings to let the air into the classrooms, and they provided ample openings on the opposite side to let the air out. There were no trees or buildings to interrupt the wind. It seemed a perfect situation for making use of the cool breezes for providing comfort in hot months. But when the school was occupied, complaints came from the teachers and students that the classrooms were hot and there was no feeling of air movement within the rooms. The architects went out to investigate. Although there was very ample air flowing across the classroom, they found it was flowing along the ceiling instead of at the "living zone," and the cause was not in the location of the windows, but in the design of the windows themselves. They were of the conventional architecturally projected type, and the horizontally pivoted vane was

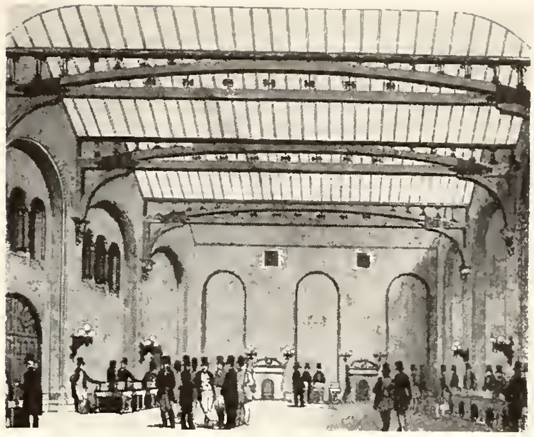
How Depth Affects Lighting



68. Take a look at these three graphs and see the effects of the depths of classrooms on natural lighting. The cross-section "A" is a typical unilaterally-lighted situation, 12 ft. high and 24 ft. deep. The cross-section "B" has all things equal to "A" except the depth, which is 28 ft. And "C" is a similar situation, except that the depth is 32 ft. The results of tests as recorded in these cross-sectional graphs prove that as the depth is increased in unilaterally lighted classrooms, the illumination decreases. Also, as the depth is increased, the drop of illumination (diversity) across the classroom increases. Note that the drop for the 24-ft. deep classroom is 2.6 to one, compared to 3 to one for the 32-ft. deep classroom. These tests relate to an overcast sky and to rooms having the window heads at the ceiling.

Good Use of Top Lighting

69-73. Top lighting is not new, as the building at the right, constructed about 1850, indicates, but in the last few years, school architects have taken advantage of this excellent technique for providing efficient, economical and well-lighted classrooms. The photographs below are achieved with some excellent examples of well-integrated natural and artificial lighting systems using this technique.



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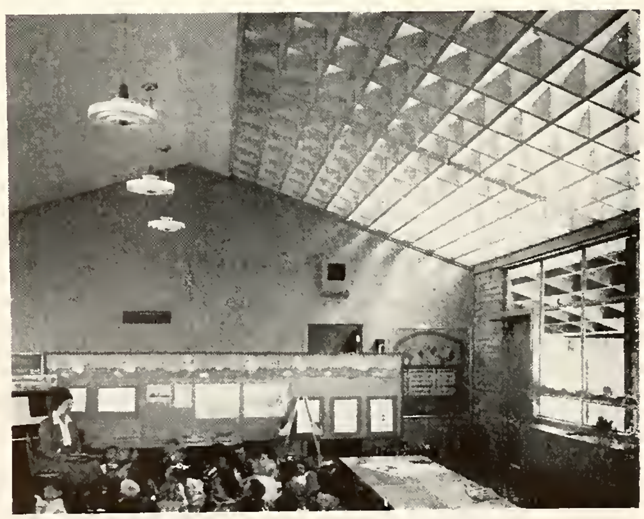

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directing the air to the ceiling. Had the vane been designed to have a greater angle turn, the air could have been directed down toward the children, and made them feel cooler because of the air movement around their bodies.

This case and other similar ones prompted researchers at the Texas Engineering Experiment Station to investigate various types of standard manufactured windows.[21] The results of this particular project indicate that the window acted like a nozzle on a water hose in controlling the direction of the air flow into the classroom. Here the air flow pattern through the classroom was determined almost entirely by the direction from which it entered the classroom through the windows and hardly at all by the kind, size, or location of the outlet openings. This research work on standard manufactured windows gives evidence that window designers have apparently been interested more in winter ventilation than in summer ventilation. A great number of windows commonly used in classrooms have hopper vents which throw the air to the ceiling. This is an excellent device for bringing in the very cold winter air and shooting it to the ceiling to mix with the hot air before it filters down to the children. For cool weather it is wonderful, but for hot weather it is highly unsatisfactory. For comfort during hot weather, the children must have that movement of air around their bodies. There are some manufactured windows so designed that the hopper vane can direct air either upward for winter ventilation or downward for hot-month ventilation. This point can stand repeating. A window properly designed for a classroom to be used in areas where natural ventilation is important should be one through which, in the hot school months, the air can be directed downward to flow around the bodies of the children, and during the cold school months, the air can be directed to the ceiling to mix with the hot air which rises. There is a case in one school where natural hot-month ventilation was a prime consideration and the architects had projected windows installed upside down in order to achieve a downward air flow to the living zone!

As a summary to this discussion on windows, we can conclude: (1) that the window is not necessarily the only solution to facilitating lighting and ventilation, (2) that the inlet openings, whether they be ventilating vanes of standard windows or simply openings in solid walls, control the air flow across the classroom, and (3) that in regions where hot-month cooling is important, windows which have vanes which can throw the air both upward and downward should be specified.

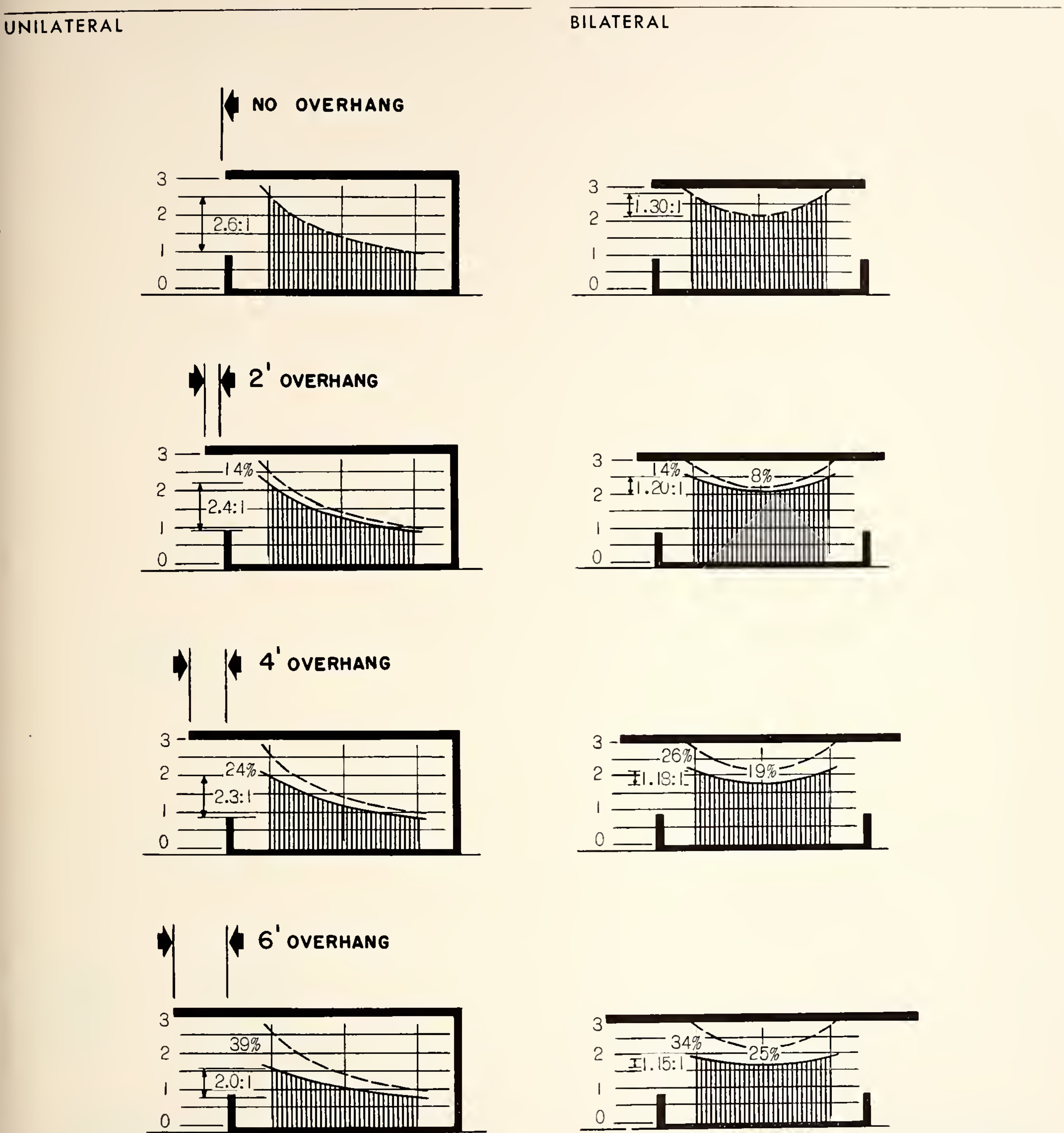
THE DOUBLE-LOADED CORRIDOR CLASSROOM ARRANGEMENT

Not too many years ago, some state codes required that the axis of each and every school building be oriented north and south. These codes were based apparently on two false premises: (1) that all classrooms should have sunlight part of the day, and (2) that all classrooms were arranged on either side of a central corridor. The first has already been discussed. It is quite obvious today that there are other good solutions to classroom arrangement than the so-called double-loaded corridor, although the large majority of our schools today are based on such arrangements. Classrooms situated two sides of a corridor can be properly ventilated and lighted by natural means, but not if they are designed in the traditional manner, with unilaterally lighted and ventilated classrooms. If one side of the building is turned to the breeze, then the other side is in a wind shadow. If the axis of the building is turned to the breeze, then the air flows down the hall and around the building, causing all classrooms to be in wind shadows. It has already been explained how poorly unilateral plans perform as far as lighting is concerned.

For these reasons, and others having to do with expansibility, the single-loaded corridor classroom wing arranged in a finger plan has been very popular of late. With such an arrangement, both good natural lighting and good ventilation can be achieved. The classroom wings can be grouped far enough apart so that one wing will not interfere with the other as far as prevailing breezes are concerned. Architects can easily obtain openings on two sides of the classrooms for ventilation and lighting. But the finger plan is not necessarily the only solution to the school plant problem. Sometimes, because of site limitations, it is unfeasible. Some architects claim that because of the large perimeter it is not particularly economical. Some of the educators object to the administrative inefficiency of such a loose-jointed layout. This discussion does not intend to argue the merits one way or the other. Certainly everyone will agree, however, that in certain situations the finger plan could be a wonderful solution to the problem. But if for reasons of site limitations, cost, or efficiency the only solution must be a double-loaded corridor school, can architects devise classrooms to give good lighting and good ventilation with such a layout?

Yes, they can. For example, Case Study 4 is a double-loaded corridor arrangement with the corridor designed as an air flow duct. This corridor has been made large enough to scoop up the prevailing breeze and dam up the air as a reservoir; then with a system of grills and baffles, the air is evenly distributed from the corridor into the classrooms. The school is lighted by a skylight arrangement on a butterfly type cross section. Another double-loaded corridor solution, Case Study 15, shows the use of the corridor as a light plenum chamber. The corridor is flooded with light through skylights at the ridge, the light then being admitted to the classroom through continuous corridor windows. The ventilation arrangement for this scheme provides for orienting the

How Overhangs Affect Lighting



How Overhangs Affect Lighting

74. Do overhangs hurt interior lighting? A study of the results of testing illustrated here will show that sometimes they do, and sometimes they help the over-all lighting situation. Look at the first vertical column, which shows the results of the testing of four unilateral classrooms: one with no overhang, one with 2-ft. overhang, one with 4-ft. overhang, and one with an overhang of 6 ft. Note that the 6-ft. overhang cuts down the light at a point near the window 39 per cent, and at a point near the opposite wall 22 per cent. This drop in the intensity certainly should be considered a disadvantage. The installation of the overhang did flatten out the distribution curve, however. Now compare these figures with the bilateral situations recorded on the second vertical column. In every case the intensities are high and the distribution better. These results show that since bilateral classrooms produce such high intensities, the disadvantages of cutting down intensities at interior points are offset by the advantage of improved distribution. Therefore overhangs in bilaterally-lighted classrooms can actually improve the general lighting patterns.

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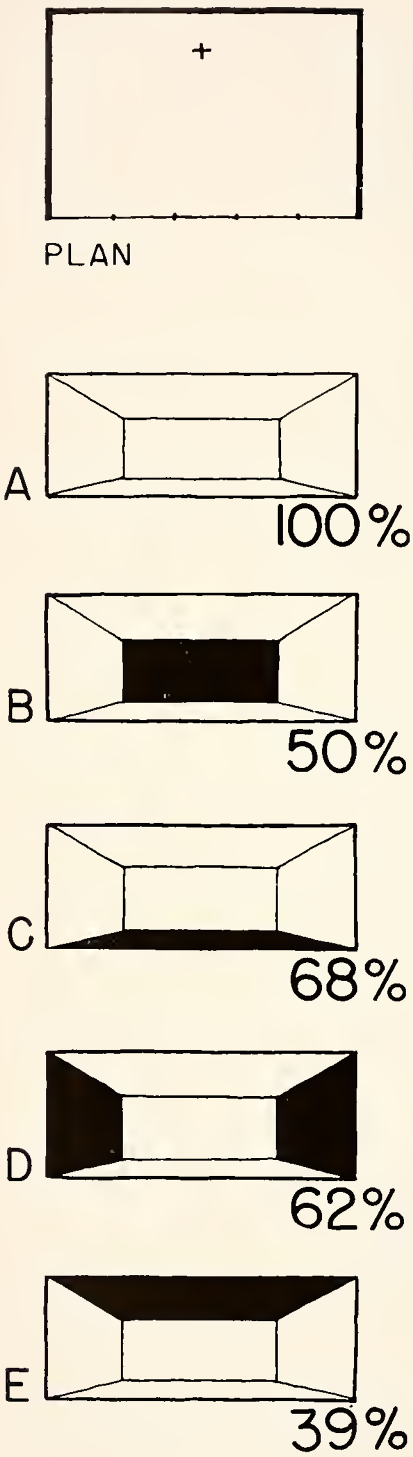

Light Reflectivities of Unilateral Classroom

75. What part does the ceiling play in reflecting light in a unilateral classroom? What part do the walls play? And what part does the floor play? These diagrams offer answers to such questions. The first diagram is a floor plan of a classroom, 24 ft. deep and 12 high. The point "+" marks the position of the lowest intensity in this situation. If all the walls are painted white, (maximum reflectivity), the point then will have maximum lighting. This condition is represented by Diagram A. Now let us see what happens when the effect of the back wall is removed from this complex picture of inter-reflection. By eliminating the light which bounces off the back wall, the point in question is dropped to 50 per cent of the original lighting set-up. See Diagram B. Now let us try to isolate the effects of the floor. Here again all surfaces are left white except the floor, and it is painted black. See Diagram C. Here illumination at the point is as much as 68 per cent. Now what do the side walls do? With everything painted white and the side walls black it is found that the light is reduced to 62 per cent of its original value. See Diagram D. Now, for a really significant figure, consider the last diagram. Here again all surfaces were painted white except one, in this case the ceiling. The point at the back of the room dropped to 39 per cent of the original figure. This emphasizes the great importance that ceilings have in unilateral classrooms as far as reflectivities are concerned.

Light Reflectivities of Bilateral Classroom

76. The preceding illustrations show the separate effects of walls, floor, and ceiling on the inter-reflectivity of a unilaterally-lighted classroom. Now let us see comparable figures for the bilaterally-lighted classroom. The proportions of this classroom are exactly the same as for the other, except that high windows have been added on the wall opposite the main window source. Under this situation the low illumination point is automatically moved toward the interior of the room, to the position indicated as "+" in the diagrammatic plan. Diagram A, therefore, shows all of the surfaces within the room painted white (maximum reflectivity). Diagram B shows the back wall painted black (minimum reflectivity), and illumination of Diagram A at the low point reduced to 72 per cent. Compare this with the unilateral situation, and we may conclude that the back wall of a bilateral situation could possibly have a lower reflection factor. Now refer to Diagram C to see the effects caused by darkening the floor. When the floor is painted black and all other surfaces white, the reduction is about the same as in the unilateral classroom. Now let us consider the walls. According to Diagram D, painting the walls black reduces the original lighting to 67 per cent. Diagram E shows the separate effect of darkening the ceiling. Note a reduction only to 49 per cent in comparison with the 39 per cent of the unilaterally lighted classroom. We can conclude, therefore, that very high reflective surfaces are not so important in bilaterally lighted as in unilaterally lighted classrooms.

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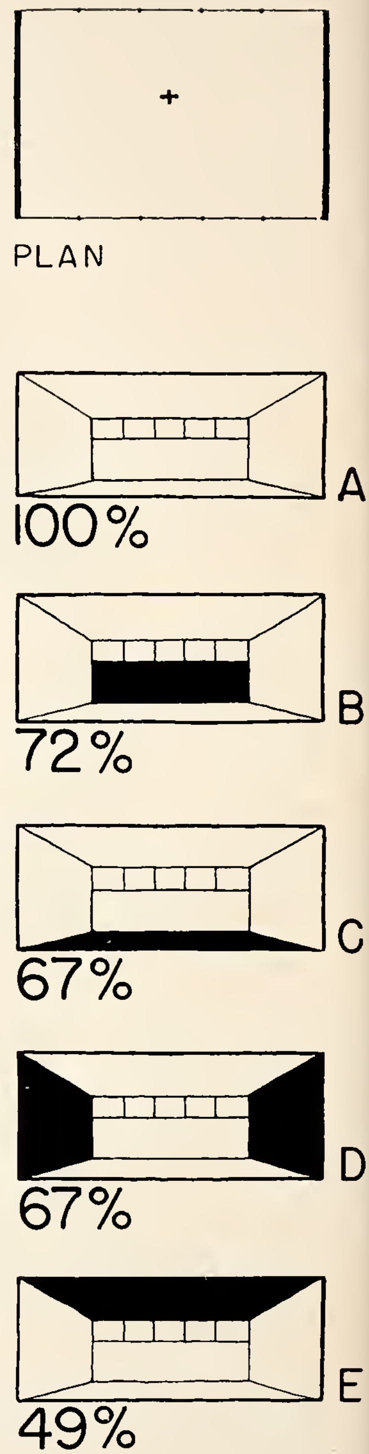


axis of the building perpendicular to the wind and directing the air flow through one classroom, over the corridor ceiling, and into the opposite classroom. These two solutions have great significance because they point out that if properly handled a classroom with any exposure may have proper lighting and air flow.

An entirely different solution, but just as effective, is Case Study 16. Here lighting is obtained through clerestory windows located approximately at the midpoint of each classroom, and ventilation is facilitated by three openings in each classroom. Case Study 30 is another good solution, consisting of a dropped central corridor which allows clerestory windows above for both ventilation and lighting. And Case Studies 37 and 70 are still other good solutions to the problem. For a combination double-loaded and single-loaded scheme refer to Case Study 64.

REFLECTIVITY OF SURFACES

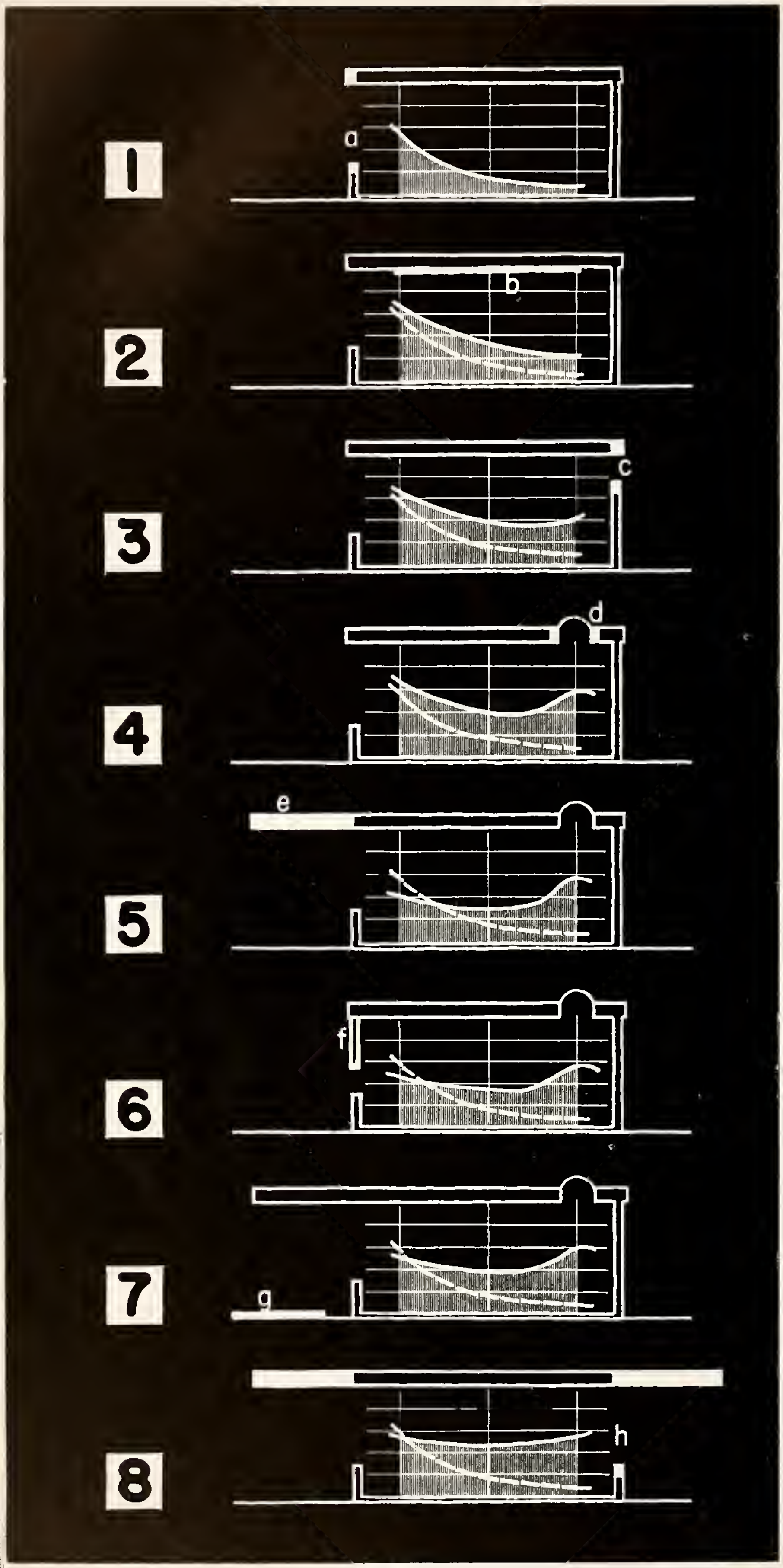
This brief discussion of reflectivity will have to be limited to lighting, since as far as we know air flow caused by the wind is the same around a white surface as it is around one painted black. It is a well-known fact that reflectivities of surfaces in a classroom have a very definite effect both on the level of illumination and on brightness contrast. Authorities recommend that ceilings have a reflectivity of about 85 per cent (it is rather difficult to go any higher), that walls have approximately 60 per cent reflectivity, and floors approximately 40 per cent. These recommendations are backed by experimentation, but generally only the standard unilaterally lighted classroom was considered. What about bilaterally, trilaterally or quadrilaterally lighted classrooms and so on? It stands to reason that the more light gets into a classroom, the lower may be the reflectivity of walls, since aside from reducing brightness contrast, the chief reason for having walls with high reflection factors, is to bounce the light back to the task surface. If a ceiling has a reflection factor of 50 per cent it absorbs half the light that hits it and bounces back half. If light in a classroom is a scarce item, then walls, ceilings, and floors should have the highest possible reflectivity. It has already been proved that multilaterally lighted classrooms have much more light than unilaterally lighted ones, so logically the recommendations for reflectivity of unilaterally lighted classrooms should not be applied to multilateral situations, particularly since multilateral lighting permits wide use of color. There are many school planners who believe that adherence to these high reflectivities produces an "anemic-looking," "antiseptic," and "pale" environment. They like color and lots of it—warm, bright, friendly colors. So opportunity for freedom in color design is another strong point for multilaterally lighted classrooms.

Only by determining to what degree the walls, ceilings, and floors affect the general illumination can color designers plan classrooms intelligently, finding a balance between illuminating engineering and color psychology. So in an attempt to find out the facts about reflectivity of surfaces, a series of tests was conducted on both unilaterally lighted and bilaterally lighted situations. Tests were made to try to isolate the effects of ceilings, walls, and floors on the level of illumination by varying the reflectivity of each surface independently of all other surfaces. Pure white (85 per cent reflectivity) was assumed the maximum reflectivity for walls and ceilings, and 60 per cent gray for the floor. The problem was to determine how much light was lost by each surface when the reflectivity was lowered. For example, in order to determine the effect of the ceiling reflectivity, tests were conducted under maximum conditions for all surfaces; then the results were compared with tests run after the classroom ceiling had been painted black (3 per cent reflectivity).

For unilaterally lighted classrooms the results were as follows:

It was found that when the back wall was painted black and all other conditions remained the same, there was a loss of 50 per cent light near the windowless wall and 9 per cent near the windows. (See Illustration 75.) By painting the floor black and leaving all other surfaces the same, there was a decrease of 32 per cent near the wall and 13 per cent near the windows. When the side walls were painted black, the point near the windowless wall had a decrease of 38 per cent, while the point near the windows came down 18 per cent. But the greatest drops were caused when the ceiling was painted black: a 61 per cent drop at a point near the far wall, and a 36 per cent drop near the windows. It is safe to conclude, therefore, that for these conditions the ceiling is the most important reflecting surface. In fact, darkening the ceiling decreased the intensity of the illumination about twice as much as the average decrease resulting from darkening all the other surfaces. However, in this unilateral situation the back wall reflectivity is very important too, since the light at the critical point near the back wall was cut in half when the wall was darkened. It must be conceded that surfaces must have high reflectivities in unilaterally lighted classrooms. But, are they so important in bilateral situations?

Similar tests were run for the bilaterally lighted classroom. Painting the comparable back wall black reduced the light 28 per cent near that wall in comparison to 50 per cent in the unilateral situation. It should be pointed out here, however, that although the intensity at that point was dropped 28 per cent, there was much more light to start with; bilaterally lighted rooms admit much more light than unilaterally lighted rooms. When the floor was darkened it had about the same effect as in the unilateral series, and the same held true for walls. The ceiling test showed a 51 per cent drop in comparison to a 61 per cent drop at the same point in the first series.

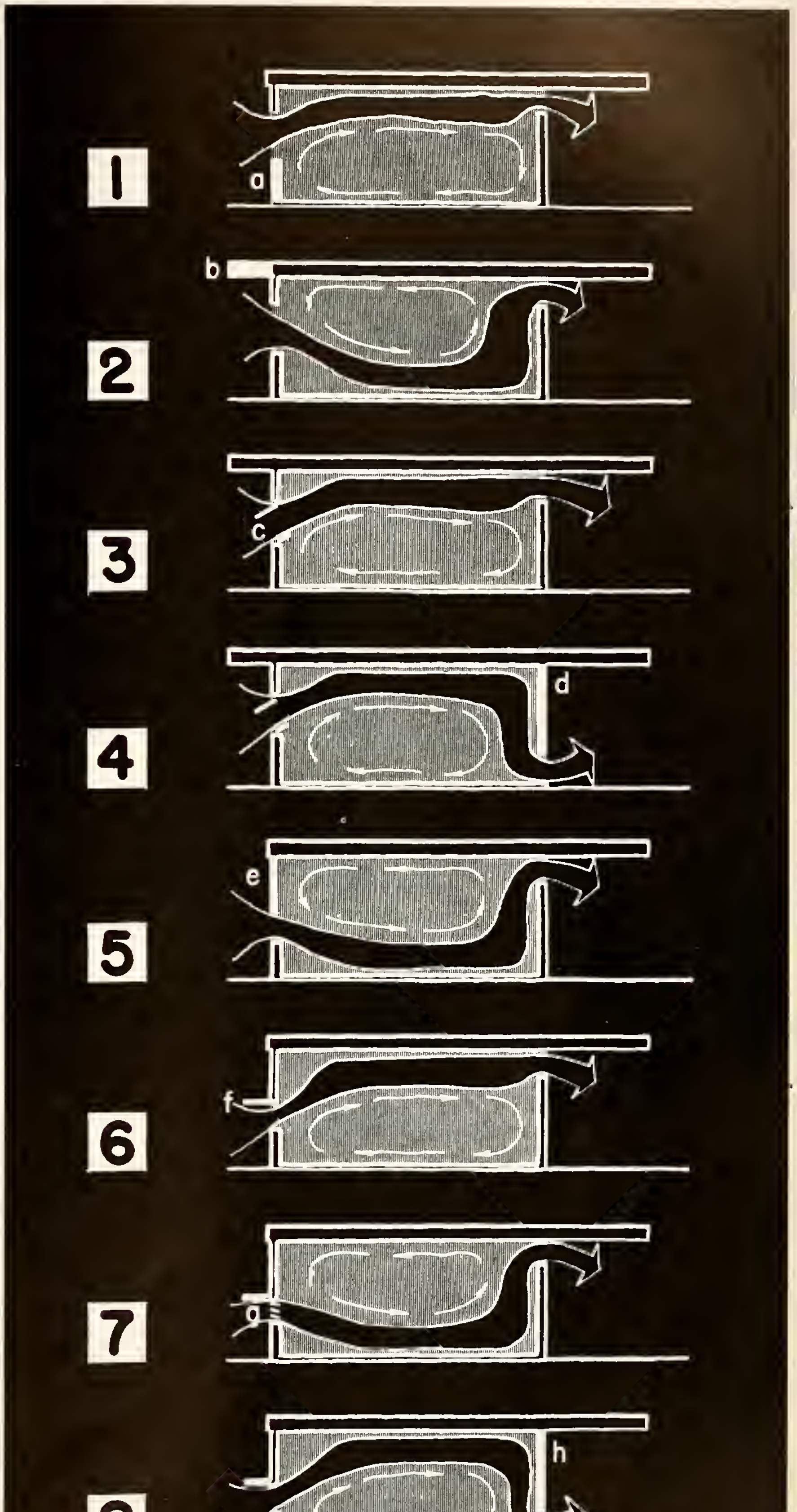


How Light Behaves Within a Classroom

77. These cross-sectional diagrams show how light behaves within a classroom when certain shapes, materials, and reflectivities are changed. First, let us start with a fixed set of conditions, a unilateral situation of certain proportions. See Example 1. The window at "a" allows so much light to enter the room and the curve takes on the shape as shown. Now refer to Example 2. Here the reflectivity of the ceiling "b" has been substantially increased. The distribution curve flattens out somewhat, since the increased reflectivity does the most good near the windowless wall. The dotted line is the original light curve, and will be repeated throughout for comparative reasons. Let us now assume that the curve needs to be brought up near the windowless wall still more. What can we do? For one thing we can introduce an opening at "c" as in 3. Another way is to install some sort of skylight, as "d" in Classroom 4. By either of these two ways high intensities may be obtained near the wall opposite the main light source. These two examples are strong arguments for multilateral lighting. Now let us assume that we need to straighten out the curve still further. One way is by providing an overhang, "e," in Classroom 5. The overhang lowers the light near the main window source at a much greater rate than in the center. Another way that we can do this is by introducing some material like glass block or a device like the louvers at "f" in Classroom 6. Let us now assume that although we straighten out the curve somewhat, we would like to increase the intensity a little bit more. We have evidence that by increasing the ground reflectivity at "g" the light within the classroom will also be increased somewhat. See Classroom 7. Now, as a final experiment, let us assume that we want a high level of illumination, evenly distributed. How can we get it in this classroom shape? One good way is to open up both sides to get as much light as possible, then install overhangs to form a flat curve within the walled area.

How Air Behaves Within a Classroom

78. In order to show the behavior of air flow within classrooms of various geometric conditions, let us assume one set of conditions. By changing the individual parts we can then see the corresponding changes in air flow pattern. The assumed classroom shape in this case is a bilaterally vented envelope as shown in Classroom 1. By virtue of the solid area at "a" combined with the ground effect, there will be a strong upward component which will cause the incoming air to flow towards the ceiling. Classroom 2, shows what happens to the interior air flow when an overhang is added at "b." This is a very marginal case, but the addition of the overhang causes the air to flow downward by building up a higher pressure above the opening than below it. The two previous conditions concern a simple opening, one with no vanes. Now consider Classroom 3. Everything is the same as in No. 2. except that the inlet opening now has the projected type V sash, "c." The air now shoots upward, which bears out the premise that the type of the opening is one of the most important factors in determining the air flow. Classroom 4 is exactly the same as No. 3 except that the outlet has been changed on the wall "d" from the ceiling to the floor. Note that the pattern across the room is essentially the same. It is the inlet that determines the air-flow pattern, not the outlet. Now consider Classroom 5. The overhang has been removed, and the inlet has been lowered on wall "e." The opening in this case has no vanes. This case is similar to Classroom 1 except for the location of the opening on the wall, but unlike No. 1 the air flow pattern is downward. This is because flowing along the large wall area "e" gives the air a strong downward component when it enters the opening. In Classroom 6 an overhang "f" has been added immediately over the opening, similar to the sun shades in typical glass block fenestration. The overhang stops this downward component and the air flow is upward again. But if a louver type of arrangement is added at "g," then the air can be made to flow downward again on the children, where it can do the most good. See Classroom 7. Now if the louvers are removed, the air flow in 8 still goes upward regardless of whether or not the outlet on the wall "h" has been brought down to the floor.



LIGHT ABSORBED BY THE PUPILS

Recent preliminary findings of tests conducted by the Texas Engineering Experiment Station show that the pupil is pretty much a light obstructor. If seated and bent over writing, he can reduce the available light on his task as much as 60 per cent in a unilateral situation with his back to the light source. In a formal seating arrangement with light coming over his left shoulder (provided the pupil is right-handed) he absorbs enough light to reduce the illumination on his task about 25 per cent. These conditions, of course, depend to some extent on the clothes worn by the pupil. In some cases it was found that the intensity on the task is actually increased because of light colored clothing. Surprisingly enough, these tests indicated that the *mass* of pupils does not absorb enough light to reduce the over-all intensities appreciably. Again it is the *individual* pupil that counts; he absorbs light, and most of the time lots of it. This cannot be ignored by school planners. Yet for the most part the few present-day classrooms that give evidence of serious thought to lighting have been designed as *empty* classrooms. A good rule of thumb is that in order to be on the safe side, the lighting of classrooms should be designed to be 50 per cent more than predicted for an empty classroom. Architect Henry L. Wright, who possesses a wonderful sense of humor as well as other great capabilities, says there is another way: "Why don't we have each class the first thing in the morning walk single file through a shower of white paint? That way the pupil will have the right reflection factor. It will take care of the overly-tanned ones too." Wright's remarks were aimed at those school planners who carry these formulae of reflectivities to four decimal places. Like all other considerations of school planning, the reflectivity of surfaces must be given important consideration, but also be related to the total problem.

CONSIDERATIONS OF GROUND LIGHT

Most of us think that light which enters the classroom comes from the sky only. This is not quite the case; in fact on some days, under certain conditions, more light comes from the ground than from the sky, particularly if the day is clear and the sun is shining on adjoining classroom terraces and yards which have high reflectivities. According to preliminary reports of the Texas Engineering Experiment Station, the following observations about ground light can be made: (1) If the sky is overcast, the classroom lighting effect from ground light is insignificant. (2) If the sun is shining and the sky is clear, ground light is significant. (3) The efficiency of louvers and overhangs is greatly affected by ground light. (4) The interior lighting curve caused by ground light is relatively straight. We should remember, therefore, that light is all about the classroom, even from the ground outside.

A SUMMARY—HOW LIGHT AND AIR BEHAVE WITHIN A CLASSROOM

Up to now in this chapter we have discussed the envelope, particularly the classroom envelope. We have talked about openings for light and air, geometric shapes, and reflectivities. Now let us try to put them together to see interplay of these varying factors under a variation of set classroom conditions. Illustrations 77 and 78 may show these effects.

THE ENVELOPE HAS UNLIMITED POSSIBILITIES

If this book does only one thing; then the time, energy, and money that made it possible have been worth spending. That one thing is to convey to its readers the simple fact that *there are no stock answers to school building problems.* This is particularly true with the problems connected with the design of the envelope. New building materials, new construction techniques, new planning arrangements are all directed towards perfecting the envelope. Beautiful and functional school buildings represent only steps towards perfection, not perfection itself. There is no one school plant that has all the answers, there is no one perfect classroom. The envelope has unlimited possibilities.

Up to this point most of the discussion has been given to either unilateral situations or bilateral situations. But why should the design of classrooms be limited to either? It has already been proved that unilateral situations are unsatisfactory for deep classrooms unless extremely high ceilings are tolerated, and high ceilings cost money. Even conventional bilaterally lighted classrooms can be too deep for proper lighting. So why limit classroom fenestration to one or the other?

What if it were necessary to build a low cost, minimum perimeter school, the area of which would cover about an acre? Or what if it were necessary to build an interior teaching space 50 ft. deep, with provisions for good natural lighting and adequate ventilation? Or what if a school had to be built under one umbrella-type roof so designed that wherever partitions were placed good natural lighting and ventilation would prevail? Can such schools be built?

They cannot if architects are limited to the use of the unilaterally lighted room, or even the conventional bilaterally lighted room. But, it is quite possible to do such things if they throw away a few preconceived ideas of what a schoolhouse should be like and look like. Architects of industrial buildings have already solved some of these problems.[26] They have covered acres of floor-plane operations with practical shells which admit light and ventilation through the roof. Such techniques are already creeping into school architecture. Is it impossible for architects to take advantage of ventilation techniques used in ship design, and have schools with ventilators on the roof to scoop the air into the class-

room and reversible types to suck it out? Of course such devices are not new in buildings. Some 2000 years ago the Egyptians used them to ventilate their homes, calling them "mulgufs." If cost limitations or educational changes necessitate the construction of compact, low perimeter buildings, then why not modernize the mulguf, improve the skylights so they won't leak, adapt the industrial monitor or saw tooth, try out the plastic bubble, and take advantage of the ship-type ventilator? Who knows, such experimentation might result in logical school buildings. There are as many good reasons why classrooms should not be unilateral or even bilateral as there are reasons why they should be. There is no one perfect solution to the classroom problem. Every problem is a little different from the last, and requires a different solution.

So much for theory. How do the overhangs, low ceilings, multilateral fenestration act in existing classrooms? At least a partial answer may be found in the analysis of nine existing classroom envelopes shown in illustrations 79 to 87.

These graphic analyses require careful interpretation: it is easy to jump to conclusions. For example, an upward air pattern in one of the classrooms may, on the surface, look as if it has been caused by an overhang. But the location of the window opening might actually have caused the air to flow upward. There are many marginal cases like this, and it is difficult to say exactly what specific architectural shapes or devices made the light and air behave as they did. Nevertheless, much can be learned through studying these composite situations. When we have a knowledge of the effects of the separate situations, and have become experienced observers, we can trace the cause of faults in existing classrooms and even anticipate, to a certain degree of accuracy, the lighting and ventilation performance in proposed classrooms.

THE PROBLEM OF NOISE IN THE SCHOOL PLANT

As it was pointed out in Chapter 1, an aspect of pupil health and comfort is the attainment of peace and quiet within the teaching areas. But how can this be achieved? What can be done about the problem that Pupil Joe has in trying to hear Teacher Smith lecture in a room where sound bounces around like a rubber ball? What can be done to help Teacher Jones, who must talk above the constant din of a busy thoroughfare? What can be done about the disturbing noise from the band room? And the shops? And the gym? And the choral room? And the playgrounds? Unfortunately, the recent activity trend in the educational program with quiet and noisy activities going on simultaneously, has only made the problem worse. We have a long way to go before we can find answers to the questions listed, but an understanding of some of the basic planning aspects of architectural acoustics will put us in a good position to solve them. The study of acoustics is much too complex to be discussed here in detail, but it is hoped that the following outlined account of the basic problems will increase the scope of our total planning concept by including sound as well as light and air. If we boil down the preceding questions concerning the problems of noise, what do we have? What is our task? It is simply this:

1. To prevent disturbing sounds from entering the teaching areas.
2. To provide good hearing conditions within the teaching areas.

Let us consider these in the order listed to spot and label the problems and to see what can be done about finding some of the answers.

KEEPING THE NOISE OUT OF THE ENVELOPE

To keep sound out we must know where its source is and how it gets in. As far as the school plant is concerned, the chief noise sources are band rooms, the shops, noisy classrooms and laboratories, gymnasiums and playrooms, playgrounds, choral rooms, and corridors of the school, as well as automobiles, trains, and noisy establishments adjacent to the school plant. These kinds of sounds can penetrate the envelope through ceilings, walls, and floors if these elements are not designed to resist them. Even if the structure is sound-resisting, the noise can enter enclosed spaces through doors, pipe sleeves, ventilating ducts, and the like. But the great leak of the envelope is the open window. And there is not much that we can do about it, particularly during the hot school months when windows must be open for comfort. One of the banes of school planning is the fact that where air will flow, sound will also be transmitted. One of these days some bright architect will develop a window that will let air and light in and keep sound out, but we do not have such a thing now, although the author and his architectural associates, with Dr. E. G. Smith as a consultant, have developed a partition (reference is made to the Core in the next chapter) that lets the air through and filters most of the sound out. But until we learn more about how to treat openings in the envelope, we must depend on planning techniques for isolating the sound source. The answer is Zoning with a capitol Z. And zoning starts with the entire community, not just the school plant. (This phase of planning will be discussed in detail in Chapter 5.) The school plant itself is actually a little community, too, with its own industrial area (shops and laboratories), its commercial area (cafeterias, office, and assembly and recreational units), and the residential area (the classroom unit—the "home away from home"). A zoning plan is just as essential for a school plant as for the community. The noisy elements of the school plant

These nine well-known classroom shapes represent many geometric situations—unilateral, bilateral, and even a trilateral. Some have

A

Del Mar Elementary School

Fresno, California

Franklin & Simpson, Architects

Plan type—single-loaded outdoor corridor

Ceiling shape—Flat

Ceiling height—0.34 room depth

Openings—Large windows opposite corridor side with small clerestory windows with baffles over corridor.

Lighting

Rated: intensity........first

distribution.....seventh

This classroom has the highest intensity of the nine, but the distribution rating is comparatively low. The distribution could, no doubt, be improved under overcast conditions by removing the baffles in the clerestory windows, but again, as can be seen in the photograph, they are necessary for sun control.

Ventilation

Rated: Pattern.........upward

speed...........seventh

As shown by the cross section, when the air is flowing into the large windows and out the clerestory over the corridor, there is a slow movement of air along the ceiling with a large eddy below. Again, the slow moving air stream can be attributed to the relatively large inlets and small outlets. The air stream is split and deflected partly down the corridor wall and to the floor by the baffles when the air enters the clerestory, but it does not flow very fast as would be expected, considering the large outlets and small inlets, due to the abrupt changes in direction it is compelled to make.

B

Elementary School

Welcome, Texas

Caudill, Rowlett, Scott & Associates,

Architects

Plan type—single-loaded outdoor corridor

Ceiling shape—Double slope with monitor at middle

Ceiling height—0.27 room depth at windows

Openings—Large windows on both sides of the room for light and ventilation. Monitor for light.

Lighting

Rated: intensity........fourth

distribution.....first

Although the intensity of this classroom is lower than in some of the others, its distribution is best of the nine rooms tested. The good distribution can be attributed to the fact that the overhangs hold down the intensity somewhat near the windows and the monitor builds up the intensity at the middle of the room.

Ventilation

Rated: pattern.. ......upward

speed...........first

Since the classroom is symmetrical, the air flow is the same in either direction and always results in relatively high speed flow along the ceiling.
(This is the school discussed in detail under the Window discussion of this chapter. The above test shows that a simple opening in the original window location produces upward air flow in itself. The projected windows, which had a limited rotation, only made matters worse in regard to hot weather ventilation when actually installed in the building.)

C

Baker School

Mountain View School District, California

Kistner, Curtis & Wright, Architects

Plan type—Single-loaded outdoor corridor

Ceiling shape—Sloped

Ceiling height—0.38 room depth at corridor side, 0.13 room depth at opposite side.

Lighting

Rated: intensity........sixth

distribution.....third

Although the intensity in this classroom could be increased by removing the louvers, the distribution drop would most likely increase. This could offset the value of the increased intensity since the louvers in this case serve also as sun control and sky brightness control. The probable reason for the near-even distribution is that the louvers and overhangs hold down intensities more effectively near the windows than at the middle of the room. At the same time the louvers and overhangs tend to distribute intensity evenly throughout the room by shading the area near the windows and reflecting admitted light to the center.

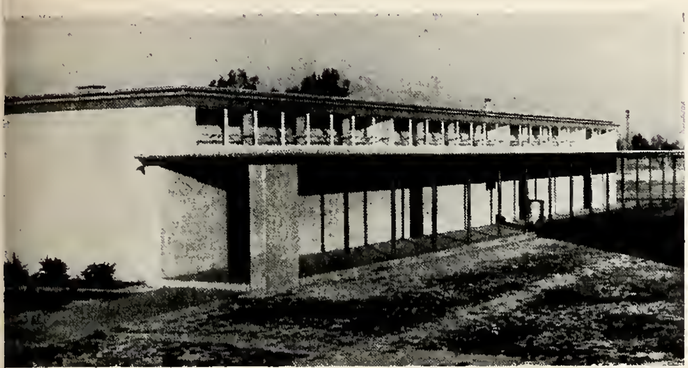
Ventilation

Rated: pattern.........upward

speed...........third

The air flow in this classroom is always along the ceiling but relatively fast in either direction. The speed of the air movement is slightly higher from right to left than from left to right because of the unequal openings.

high ceilings, others low ceilings. Some have unprotected glass areas, others have overhangs and louvers. By studying these nine classrooms we should be able to anticipate more accurately the lighting and ventilation performance of proposed classrooms.



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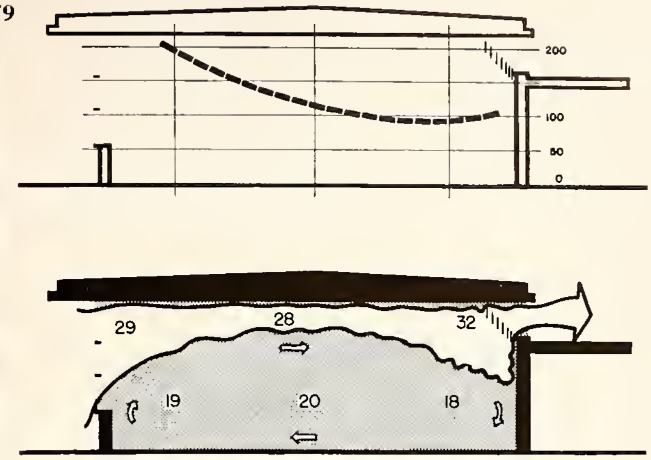

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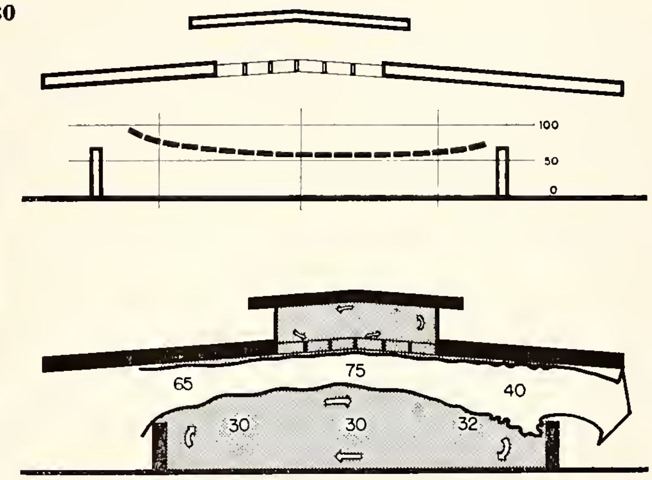

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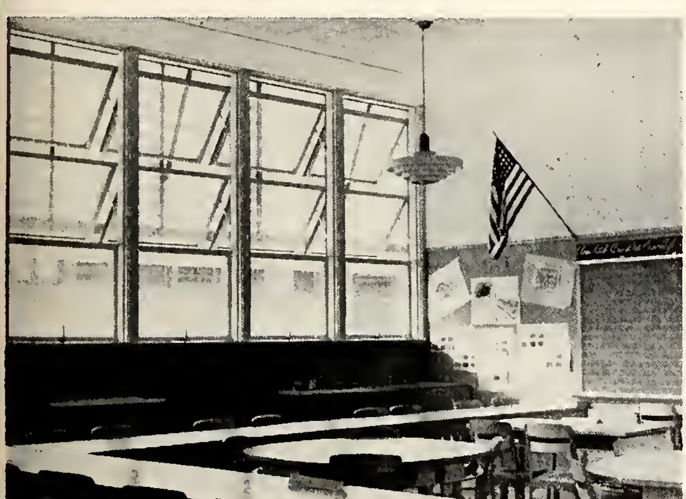

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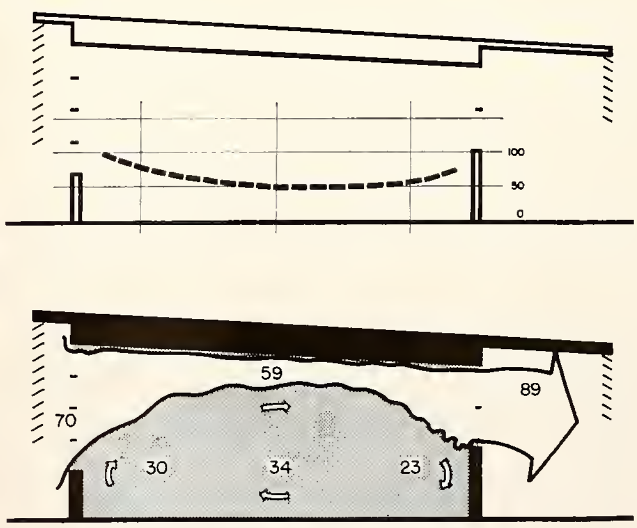

C

D

Elementary School

Carmel, California

Kump and Falk, Architects & Engineers

Plan type—Single-loaded outdoor corridor

Ceiling shape—Double slope with clerestory

Ceiling height—0.32 room depth at outside walls, 0.18 room depth at clerestory.

Openings—Small, high openings on corridor side, large low strip windows and small clerestory openings opposite.

Lighting

Rated: intensity . . . . . second

distribution . . . . . fourth

The intensity in this room is quite high and the distribution good. Since it appears that a large portion of the light in the middle and near the corridor side of the room is supplied by the clerestory, the distribution might be made even more nearly perfect by closing the slotted overhang over the large windows to decrease the intensity slightly near that side of the room. This is apparently a very well-lighted classroom.

Ventilation

Rated: pattern . . . . upward

speed . . . . second

This school's original location may not have presented a critical hot weather ventilation problem, but the situation here still prevails that the air always flows along the ceiling. This would produce very good indirect air movement for cool weather, but for maximum cooling effect in warm humid weather, such as occurs in the Gulf Coast area, this type classroom might prove to be quite ineffective unless the openings were rearranged and so treated as to cause the air to flow with sufficient speed through the living zone of the classroom.

E

Will Rogers Elementary School

Stillwater, Oklahoma

Caudill, Rowlett, Scott & Associates, and Philip A. Wilber, Associated Architects

Plan type—Single-loaded outdoor corridor

Ceiling shape—Sloped

Ceiling height—0.4 room depth at outside wall, 0.32 room depth at corridor wall

Openings—Large strip windows on both sides of classroom. Windows on the side opposite the corridor are fixed glass with horizontal light baffles and a slot underneath for ventilation. (This is a school which is an example of separated lighting and ventilation.) The Corridor overhang over the other windows is 32 feet wide and serves as a play shed, in addition to a corridor.

Lighting

Rated: intensity . . . . fifth

distribution . . . . . second

This classroom's intensity and distribution ratings indicate that large overhangs are not necessarily detrimental to good lighting. This extreme overhang was designed primarily as a play shed, and is used to control south sun. The near-even distribution can probably be attributed to the horizontal baffles in the large window opposite the play shed side of the room, which no doubt hold down the intensity near those windows and probably help bounce the light across the rest of the room.

Ventilation

Rated: pattern . . . . upward

speed . . . . sixth

When the air is entering the windows at the play shed side of the room, it flows along the ceiling and moves very slowly because of the extremely small outlet. But, when the air moves in the opposite direction, it is deflected downward nearer to the living zone of the room and moves considerably faster because of the very large outlet.

F

Science Building, Texas A & M College

College Station, Texas

Carlton Adams, Architect

Plan type—Double-loaded corridor

Ceiling shape—flat

Ceiling height—0.43 room depth

Openings—Large windows in outside walls with a narrow overhang. Door and transoms to corridor.

Lighting

Rated: intensity . . . . ninth

distribution . . . . ninth

This classroom has the lowest intensity and highest diversity of the nine situations tested. Although it has strip windows as opposed to punched hole windows in Classroom No. 2, it rates lower because it has a lower ceiling proportional to its depth.

Ventilation

Rated: pattern . . . . upward

speed . . . . ninth

As in the case with Classroom H, the other unilateral situation, there is very little air movement in this classroom.

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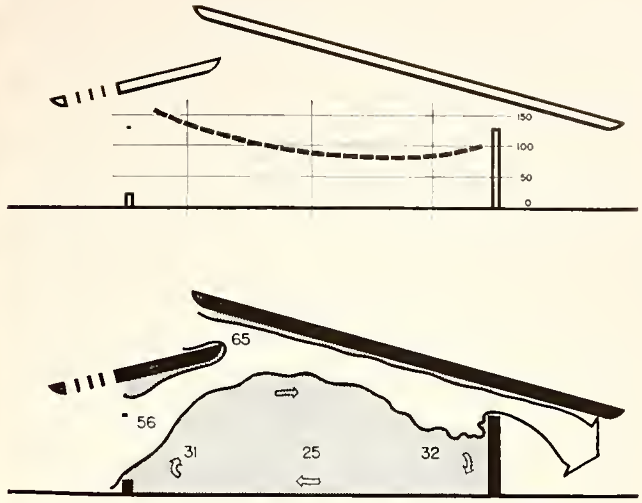
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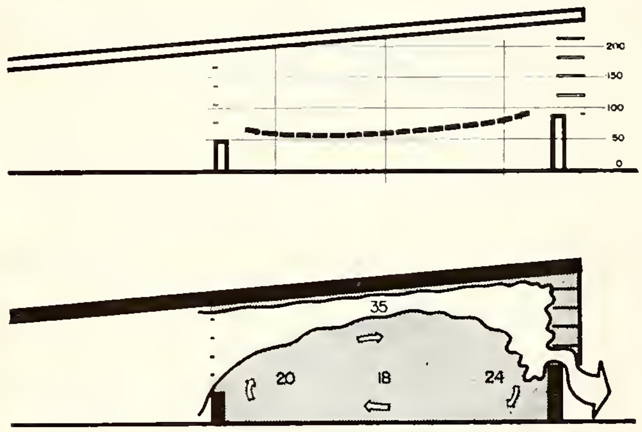
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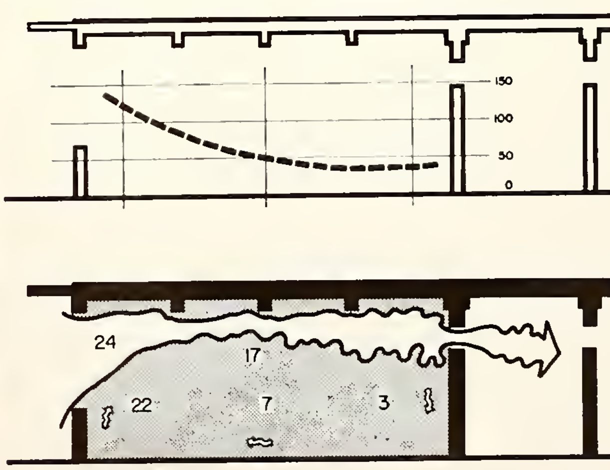
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F

G

Fairfax Elementary School

Fairfax, California

Bamberger & Reid, Architects

Plan type—Single-loaded outdoor corridor

Ceiling shape—Flat

Ceiling height—0.4 room depth

Openings—Above and below corridor roof with louvers in high opening. Large high openings in opposite wall.

Lighting

Rated: intensity........third

distribution.....fifth

It appears that the intensity near the corridor and at the middle of the room could be increased, and consequently, the distribution improved if the louvers were not in the clerestory, but the louvers in this case are necessary for sun control.

Ventilation

Rated: pattern.........upward

speed...........fourth

The air flow is along the ceiling, leaving the living zone of the room in a large eddy. When the air is flowing from left to right as shown in the drawing, the speed of the main stream along the ceiling is very fast because the outlets are larger than the inlets. This results in comparatively high eddy speeds. For a warm dry climate this might be an ideal situation. But for a warm humid climate, the air flow might be quite insufficient for comfort. When the air is flowing in the opposite direction, it will be somewhat slower because the outlet will then be smaller than the inlets.

H

A & M Consolidated High School

College Station, Texas

R. G. Schneider, Architect

Plan type—Double-loaded corridor

Ceiling shape—Flat

Ceiling height—0.5 room depth

Openings—Punched-hole windows in outside walls. One door with transom per classroom in corridor wall.

Lighting

Rated: intensity........eighth

distribution.....eighth

Although this classroom has the highest ceiling, proportional to its depth, of all nine studied, the light intensity is comparatively low near the corridor wall and the diversity across the room is high. Apparently, this is generally true in all unilaterally lighted rooms with punched hole windows.

Ventilation

Rated: pattern.........upward

speed...........eighth

As can be expected, there is very little air movement in this classroom, with only a door and a transom for openings in one wall. Of course, when the door and transom are both closed, there is no cross-ventilation at all, and even with them open, the air movement is quite inadequate. Notice that the air flows across the ceiling when moving in either direction.

I

Blyth Park School

Riverside, Illinois

Perkins & Will, Architects

Plan type—Double-loaded corridor

Ceiling shape—Sloped ceiling in the classrooms and a flat dropped ceiling in the corridor

Ceiling height—0.29 room depth at the window side of the classroom and 0.44 room depth at the corridor side.

Openings—Large, low strip windows in the outside walls; small, high openings over the corridor; some fixed glass between corridor and classroom for corridor lighting.

Lighting

Rated: intensity........seventh

distribution.....sixth

This classroom achieves bilateral lighting by use of a dropped corridor roof. The intensity, although much higher than either unilateral classroom (nos. 2 and 6), is somewhat lower than the other classrooms, and the distribution is rated fairly low. This can most likely be attributed to the extremely low ceiling; Its proportion to room depth on the main window side being 0.29 makes it the lowest ceiling line in all nine classrooms.

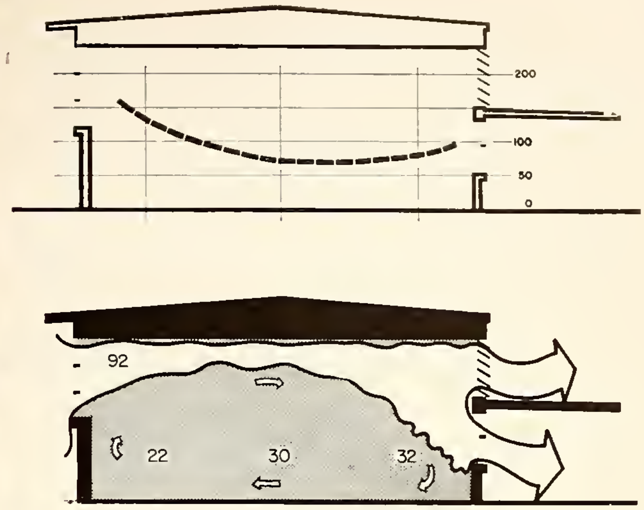
Ventilation

Rated: pattern.........upward

speed...........fifth

Again, the air flow is always along the ceiling in this classroom regardless of the direction in which it flows. It does, however, flow into the leeward classroom through the clerestory openings above the corridor.

85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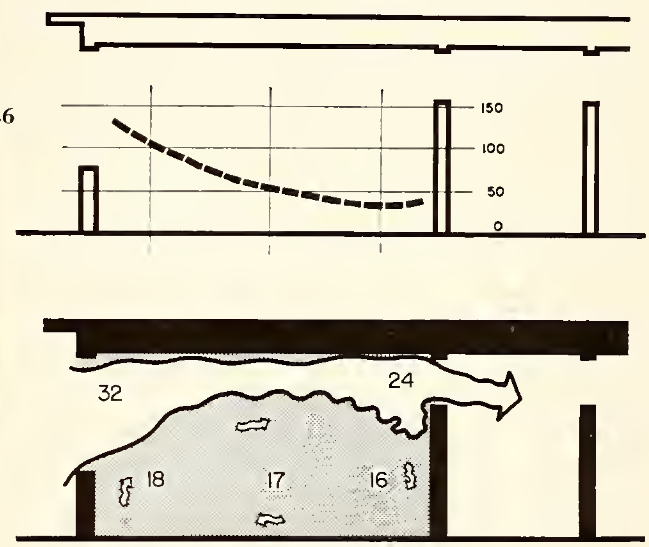
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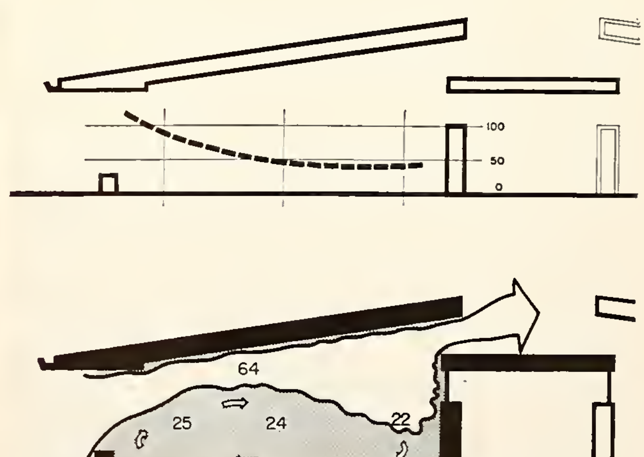
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I

	Intensity	Distribution	Pattern	Speed
A	1	7	UP	7
B	4	1	UP	1
C	6	3	UP	3
D	2	4	UP	2
E	5	2	UP	6
F	9	9	UP	9
G	3	5	UP	4
H	8	8	UP	8
I	7	6	UP	5
	LIGHTING		VENTILATION	

88. Here is a graphic comparison of the nine classrooms shown on the preceding pages. Classrooms B, D, and C held up particularly well in the scoring. Classroom B had two firsts (lighting distribution and air speed), Classroom D had two seconds (lighting intensity and air speed), and Classroom C had two third places (lighting distribution and air speed).

should be placed together and isolated, either by distances or structural barriers, from the quiet area. One plan would be to put the cafeteria, gymnasium, and shops into a loud zone; the assembly unit, offices, and possibly the music rooms in a moderate zone; and the classrooms in a quiet zone. In any event, the trick is to *isolate* the sound source.

The next consideration is to *hinder* the sound from reaching the teaching area. This can be done by sound-resisting walls, ceilings, and floors, by a judicious use of exterior sound baffles. Sometimes extensions of walls help; trees and shrubs do a good job of it, too, when they are placed right. (See illustration). Acousticians tell us that noise-insulation factors between adjacent classrooms should not be less than 40 decibels.[12, 13] They also tell us that the typical cinder block partition provides less than 35 decibel transmission loss, and the wood panel partition is sometimes lower than that. On the surface, this is a strong argument for better partitions with a high degree of insulation. But here is the twist. Most schools today have continuous strip windows where the partition simply butts up against the window mullion. If the taxpayers were willing and the architects were ready to specify nearly sound-proof partitions, it would be a waste of money, at least in schools where windows must be kept open for comfort, for the fact is that where there are adjacent classrooms with open windows, the transmission loss is less than 30 decibels. But there are at least two ways to help out this situation. One is to provide extensions of the partitions several feet to the exterior, and the other is to install fixed windows next to the partitions.

The third consideration in keeping out the noises is to *reduce* them, to go to the source and see if provision can be made to cut some of the noise out. Only about 10 per cent of acoustical material that is sold is used in rooms where the primary objective is providing good hearing. The other 90 per cent is used to reduce noise. Generally, it is not practical to reduce the noise level more than 8 decibels, because reduction beyond this requires an excessive amount of acoustical materials. But bringing a noisy room such as a cafeteria or gymnasium down 8 decibels is very effective. To sum up, then, in order to keep out noises we must isolate the sound if possible, reduce it, too, if we can, and then do everything possible to block the passage of the noises.

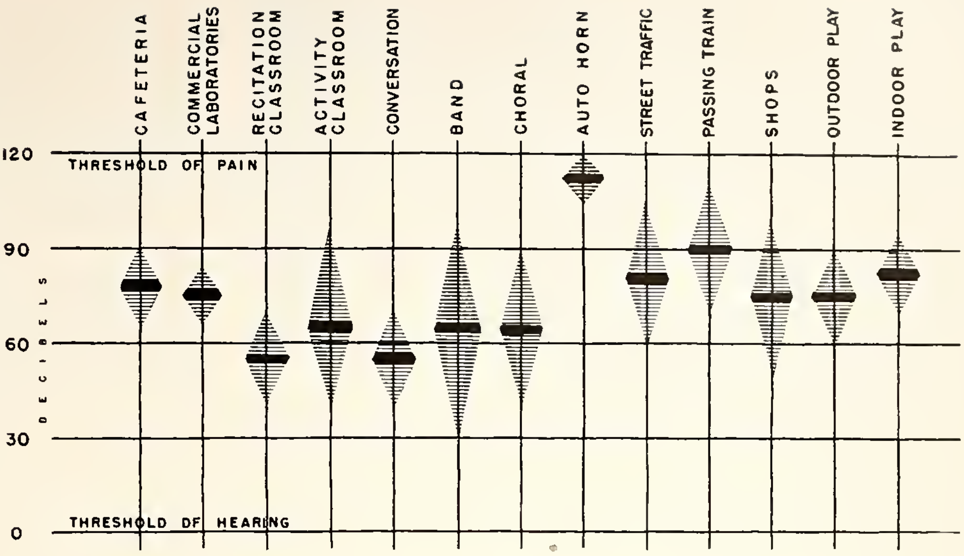
PROVIDING GOOD HEARING WITHIN THE ENVELOPE

We have talked about cutting out the extraneous sounds from the envelope, but we still must provide good hearing conditions within the envelope. In Chapter 1 it was pointed out (and it bears repeating here) that the requirements of good hearing conditions are:

1. The background noise should be low enough not to interfere with the desired sounds of speech or music. (The preceding discussion took care of that).
2. The desired sound must be loud enough to be heard without effort.
3. The reverberation time must be short enough to avoid echo and long enough to provide some blending.
4. The sounds must be distributed properly through the space.

Let us take an example. In the average classroom, the children gathered closely around the teacher who talks in a quiet tone can hear every successive individual syllable. But the children who are seated in the back of the room at some distance from the teacher can hear sounds from her voice only after they have reflected back and forth from hard surfaced walls. The sounds are prolonged to such an extent that the children hear syllables that run together like the sound of a piano with the pedal depressed. This short interval caused by bouncing sounds is called the reverberation period. Authorities recommend that the optimum reverberation time in a small recitation room should be .75 seconds at frequencies of 512 and 2048 cycles.[12] For large assembly areas, the recommended optimum approaches 1.5, depending on the activities and volume of the room. The reverberation time can be too short, and if so the room becomes "dead." Robert Newman[23] says that the common practice of completely covering the ceiling with acoustical tile provides the classroom with more absorption than necessary and makes the room

Noise Sources Within the School Plant



89. Like an automobile horn, nearly every school activity is a noise source. This chart shows some of the intensity ranges, expressed in terms of decibels. Take for example the noise which might come from the cafeteria (the first vertical column). The sound level will range from 70 decibels to 90 with the average about 80. The noise from a band practice will have greater range, from 30 decibels to 100. By knowing these data, school planners are in a position to help control sound disturbances by (1) proper treatment of the rooms where the sound originated, (2) careful zoning of the noisy elements, and (3) setting up architectural or landscape barriers between the sound source and the areas where a quiet atmosphere is essential to learning.

overly "dead." He recommends that most of the absorptive treatment be applied on the upper walls rather than on the ceiling. Although the school auditorium presents a different problem from that of the usual classroom by the simple fact that the sound must be distributed over much greater distances, its ceiling, too, should be of hard material to bounce the sound back to those in the far seats. When the sound gets back there, there should be absorptive material to keep it from rebounding and causing echoes.

But it takes more than reflective surfaces and absorptive materials to provide good hearing conditions. The architectural shape is a major consideration. A concave back wall of the auditorium (and the school world is full of them) more than often focuses annoying sounds at certain parts of the room. Parallel walls and parallel floor and ceiling cause sound to flutter back and forth like a tennis ball during match point; symmetry may have appeal to the architect but not to the acoustician. Excessive space, like that of the loft of a stage, soaks up sound energy which is needed for the audience. Here are a few items concerning architectural shape which will help hearing in the school: make walls, ceiling, and floor nonparallel if possible; even a slight irregularity is quite helpful. Tilting chalkboards and tackboards will help. Windows set askew will help, too. Use and shape walls to reflect sound as well as disburse it. The hard surface is just as important as the absorptive one. Enclose the stages of auditorium to reinforce the sound. Sometimes temporary sound boards hanging from the fly loft and others installed in the wings will do the trick. Remember that no amount of amplifying equipment will correct improper architectural shapes and treatment; it will only amplify the mistake.

This brief discussion on sound and architectural shapes should not be wrapped up without these words by Architect Herbert M. Tatum, who believes in starting at the beginning: "When the use of space demands excellent acoustic performance, an unbiased and unprejudiced consideration of its shape and its enclosing surfaces must be given at the very earliest conception of its design. Forms and devices relatively strange to architectural thinking along the usual functional, structural, and aesthetic lines, will appear as the necessary means to the end required. Sound 'sound conditioning' can be insured only in the layout of the schematic plan and by a completely open-minded development of it. Real sound conditioning cannot be obtained merely in the choice of a specification of room finishes or by the owner's acceptance of alternate ceiling materials."

One of the biggest problems that confronts school planners today is what we are to do about the noise problem tomorrow when our schools have a much greater flexibility of interior arrangements. Because of the changing educational program, we will need, and need now for that matter, an envelope which can be subdivided into large and small teaching spaces quickly and economically—but without hurting the proper sound environment. Movable partitions, as we know them today, are poor sound barriers. When large spaces are subdivided into smaller ones, usually there must be openings to facilitate ventilation, but where air flows so does sound. The author does not know the answer, but this following incident which occurred in Ferndale, Michigan, may open our eyes *and* ears to a complete reevaluation of the needs for sound conditioning in schools. The story came to the author from Wilfred F. Clapp, Assistant Superintendent of Schools for the State of Michigan, and he tells it this way. "The new school in Ferndale was not quite finished before it was necessary to move into the building. The school, designed by Eberle M. Smith Associates, was a single-loaded corri-

dor arrangement with large plate glass panels separating the classrooms and the corridor. The glass had not been installed when the children moved in, and for a few weeks the school operated with little or no barriers between the classroom and the corridor. The corridor became really a part of the classroom. When the workman came to put in the glass partitions several of the teachers remarked, 'Why put that in? We like it all right the way it is!'"* It is something to think about. Apparently Superintendent Roy W. Robinson has thought about it, for he writes, "The sound interference was so minimal that, at the teachers' suggestion, a room was constructed in the first addition to the school which eliminated the partition between the classroom and the corridor."* Maybe we can get our flexibility. Maybe the sound from teaching activities is not so disturbing as the noise from the street.

COLOR ENVIRONMENT CREATED BY THE ENVELOPE

When the envelope is placed over the teaching activities it creates a color environment as well as a thermal, a lighting, and a sonic environment. The most perfectly lighted, the most adequately ventilated and heated, and the most acoustically correct spaces can be drab and colorless. A classroom, for example, must be more than a well-lighted, properly heated, sound-conditioned box. As Architect Phil Will would say, "After all, most people are human." Truly functional architecture covers all of human life; technical functionalism is not enough. The emotional needs must be served, as well as the physical and physiological. That is why the approach described in this book is a humanistic approach. The color phase of school planning particularly lies within the circumference of humanistic needs.

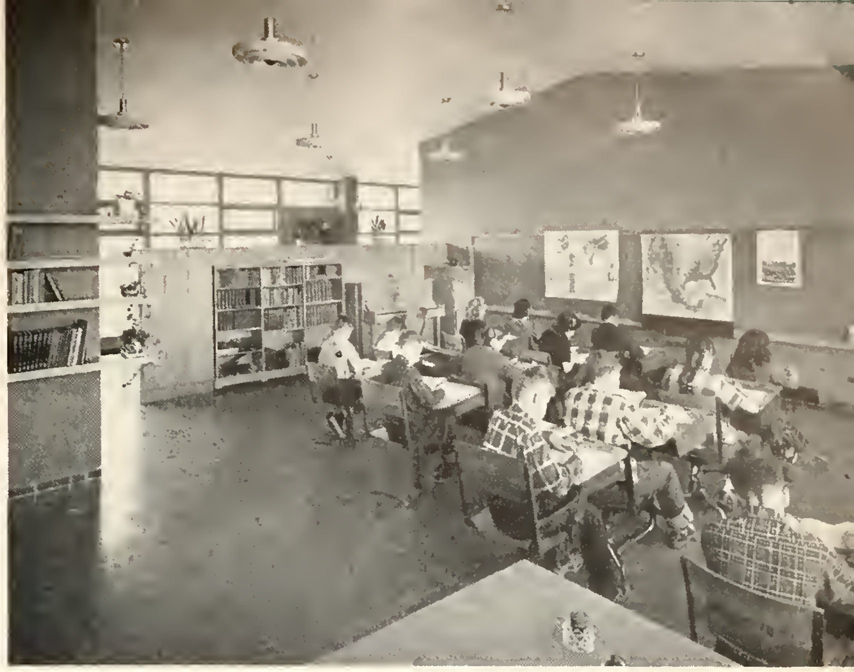
One of the nicest things that could be said about a school building was expressed by a little third grader, who, when asked what he thought about his new school, said, "It's just like springtime in the wintertime." William M. Pena, who was largely responsible for this colorful, cheerful school, believes that children are not just young adults, that they do not have the sophisticated tastes of adults. He says that youngsters of the early grades are very inquisitive about their color environment, and they like bright, bold primary colors.[24,25] But bright, bold colors sometimes might have to be obtained at the expense of high reflectivities, which poses the question, can we have good lighting and lots of color, too? Here we have the conflict between esthetic and scientific requirements. The skillful architect finds a happy balance between the two and usually comes out with both good lighting and proper color, and to do this he has to exert all his skill. But the mediocre architect would much prefer to follow set rules in designing his color schemes. And there are many for him to follow, too, some of them contradictory. Pena straightens this situation out when he says, "In the face of so many contradictions, a purely scientific approach to the use of color in schools could be bewildering in application. From the wealth of information available on the subject, an architect could compile a list of Do's and Don't's which would straight-jacket him during his planning. On the other hand, he could find scientific evidence which, applied with common sense, would release him to consider other factors affecting his planning without magnifying some minor and questionable one to the proportions of a major factor. In regard to school planning, the objective is to create a good color environment that must satisfy certain of the physical and emotional needs of the pupil. It has been my experience that there need be no quarrel between the aesthetic and scientific involved in the appropriate use of color in order to meet this objective."

Let us get down to cases. Consider the rule that classrooms facing west should have cool colors and classrooms facing north should have warm colors. Whoever thought that one up neglected to consider the seasons or else he is the type "to wear a blue suit to hell and a red one to heaven" according to Research Architect Bob H. Reed. But let us consider that this theory is correct, and that we should put cool colors on the west and warm ones on the north. What about bilaterally or multilaterally lighted classrooms? That should be enough said. Now what about the rule which specifies that the ceilings, upper walls and lower walls should be of colors with certain minimum reflectivities. Some school planners religiously follow such rules to the decimal point. They fail to realize that a pupil in a dark blue serge suit would knock the props out from any completely engineered color balance. They apparently do not know that the reflectivity rule was for unilateral situations only. There is no one formula that will work in all cases.

What kind of color environment is required in a classroom? Perhaps more research is needed before anything approaching a definite answer can be made. The research should be in the direction of what the pupil wants, not what he should have: that is, it should be in terms of needs, not solutions. At this time there are several schools of thought as to what type of atmosphere should be created. One calls for a peaceful and restful appearance, much like what can be expected in a library. Another calls for a neutral background with a minimum of color in the belief that the children themselves will provide the necessary color. Others argue that the surroundings should be stimulating to the pupil, and still other planners would like the classroom to be merely cheerful. But the consensus is a revulsion from the institutional feeling which now exists in most classrooms.

It has been said before that the purpose of the envelope is to modify nature. It can even modify na-

* by letter



An Open Plan Classroom

90. The "open plan," a new development of residential architecture, is now creeping into educational architecture. Here is a classroom space which engulfs the halls. Note the absence of doors. Another example is the Ferndale, Michigan, case mentioned in the text. Because of the ever-growing activity program, the sound problem is becoming greater; yet education is demanding more flexibility. There is no doubt about it that the solving of the sound problems is the solving of problems of flexibility conflict. What we need is a complete re-evaluation of the problems of sound. Is it necessary that classrooms be soundproof cubicles? This school certainly indicated it is not. It is reasonable to expect that the "open plan" will be seen more and more in new schools because of the great advantage of flexibility, leaving two alternatives: either (1) we find new methods for controlling sound in these open spaces, or (2) we condition ourselves and our pupils to be less sensitive to disturbing noises.

ture's color. One of the most original school designs in this country, or any country, for that matter, did just that. This school, designed by Architect Ralph B. Burkhard for the Seattle region, has a lighting system (see Case Study 76) consisting of a plastic roof and a louvered ceiling (operated by an electric eye) through which light flows into each classroom. As a means for warming up the natural light which comes from the "cold, steel-gray overcast sky" of that region, Burkhard specified a yellow plastic for the luminous roof. It works. And even on an overcast day, the classroom is cheerful.

CONSIDERING THE LANDSCAPING ELEMENTS

Outside affects inside—that is one good rule worth remembering. The landscaping elements have tremendous effect on the physical environment of interior spaces. This even holds true for color. In Texas there is a case where a cotton judging establishment went to court to have a red fence on an adjoining property painted white because the red hue was getting into the cotton laboratory. But the landscaping elements have a much greater effect on light, air, and sound. There is another case in Wisconsin, reported by Architect Edward J. Law, where a light reflecting terrace (white sand) 10 ft. wide and laid 4 ft. from the building increased the lighting at points near the windowless wall nearly 50 per cent. Consider one of the most important landscaping elements, a tree. It might cut down interior lighting to a very low intensity or it might improve brightness conditions within. A tree might also help scoop the cool breeze into the classroom, or it might keep it from entering the room. A tree also might help soak up and deflect extraneous sounds from entering classrooms' open windows. Fences and adjacent buildings have just as much effect on lighting, ventilation, and sound conditioning. The design of the landscaping is sometimes as important as the design of the envelope. To what degree these landscaping elements can affect light, air, and sound within the envelope is still questionable in certain instances, but at this writing the Texas Engineering Experiment Station is working towards finding the answer.

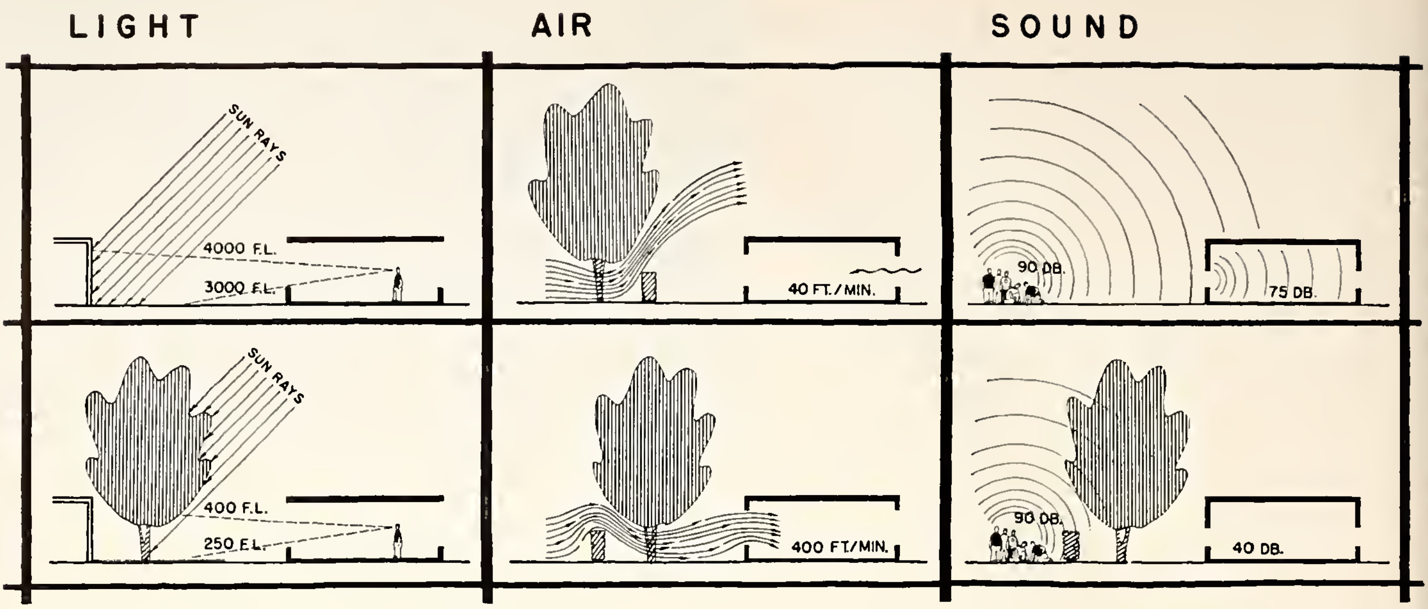
But these considerations are physical. What about the fact that trees and shrubs create rest and beauty? And what about educational benefits derived from them? John Dewey, as far back as 1900, said, "We have the relation to the natural environment, the great field of geography in the wildest sense. The school building has about it a natural environment. It ought to be in a garden, and the children from the garden would be led on to surrounding fields, and then into the water country with all its facts and forces."

INTEGRATION—KEY TO THE DESIGN OF THE ENVELOPE

The discussion of the physiological needs of the pupil (Chapter 1) did not specify whether or not the lighting that was needed for comfortable seeing conditions should be natural or artificial. Nor did the discussion say whether the necessary air temperature, humidity, and air flow should be abtained mechanically or by natural means. And it really does not make much difference, except that the natural means are usually cheaper. Comfortable light can come from the sun or lamps. Air movement necessary for comfort may be from the wind or from fans. The important thing is that there be enough and the right kind of light, and enough heat and the right kind of heat, regardless of the source. We speak of the envelope as being a necessity for modifying the forces of nature. Such modifications, of course, could be of any degree. The envelope, for example, could be only a roof to keep off the sun, or it could be a windowless shell with a complete artificial lighting system.

Today, at least, most of the classrooms come between those two extremes. Except in the cases of night schools, we use artificial light only to supplement day-

Landscaping Elements Relating to Light, Air, and Sound

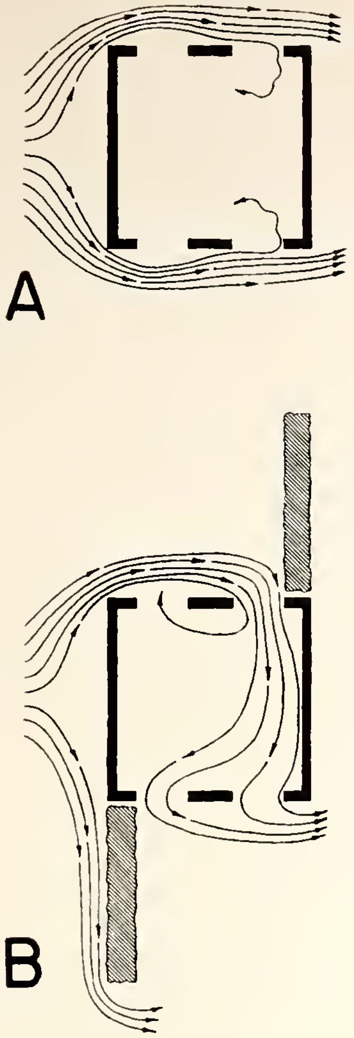


91. Landscaping elements outside the classrooms have significant effects on interior natural lighting, natural ventilation, and sound conditioning. For example, consider natural light (the first vertical column). Here is an assumed situation where there is excessive brightness in the pupils' visual fields caused by an adjacent building which reflects 4000 foot-lamberts, and a paved area which reflects 3000 foot-lamberts. If a tree had been planted and grass provided as shown in the sketch below, the brightness could have been reduced to 10 per cent of the original figure. Now consider air flow (the second vertical column). The first sketch shows how the wind hops over the classroom because of a certain arrangement of a row of trees and a continuous hedge. The second sketch shows how the wind can be diverted into the classroom by a reverse arrangement. And now consider the effects of landscape elements on sound (the third vertical column). The first sketch indicates a situation where a group of children playing outside a classroom creates a noise source of about 90 decibels, causing a sound level of about 75 decibels within the classroom. Had landscaping elements been established between the source and the classroom, as in the bottom sketch, the interior noise level could have been as low as 40 decibels.

ight. And night or day we use mechanical heating and forced ventilation to compensate for the changes of nature. Therefore it can be said that systems of artificial lighting, mechanical heating, cooling, and ventilating are for the sole purpose of modifying the forces of nature to bring them into equilibrium with the counteracting forces of man. That is a nice long way of saying that such things are for comfort only. They are here to help the envelope do its job. They are, ideally, parts of the envelope, not objects of beauty to hang from the ceiling like the old time chandelier, or to sit in the middle of the room like the pot-bellied stove. We have come a long way since those days of candles and stove wood, but not far enough. It is true we have moved the stove from the middle of the floor to underneath the window and called it a radiator, which sounds a little better and looks a little better. And we have replaced the chandelier with five or six smaller units in which we put either incandescent or fluorescent lamps which give off more light, but it is debatable whether they look any better. Yes, we have come a long way. But we still have a long way to go. These units for distributing light and heat should be integral parts of the envelope, not merely fixtures, and some of them are. The radiant panel approaches this goal. The jacketed convector does not quite make it, but the enclosed one comes pretty close. The hot air duct system approaches it, but invariably these ducts terminate in grills which punch a nice solid wall full of holes without any thought for visual appeal. Some architects and engineers feel that such half-way measures, half hiding and half exposing, represent a pussy-footed attempt at integrated design, and that it would be much better to have everything honestly exposed, even painted with bright colors to accent these systems. The completely luminous ceiling (See Case Study 39) approaches the goal that the lighting units should be parts of the envelope, not applied to it. Cove lighting approaches it, although lighting-wise it does not function as well as the concentric ring fixture, which is nothing more than a glorified chandelier with its brightness removed. But there is good news, because the trend towards lower ceilings is forcing the lighting industry to do something about it.

What this country really needs, besides that five cent cigar, is more creative engineers, who have something to offer and will offer it in the very early stages of design so that systems of lighting, heating, and ventilating can be parts of the envelope. We need more environmental engineers like J. W. Hall, Jr., of Texas, who

Landscape and Airflow



92. By the use of landscaping elements air may be made to flow through rooms which do not face the breeze. For example, consider Situation A. Here is a case where a windowless wall is perpendicular to the path of the breeze. Although openings are provided on two walls which are parallel with the direction of the breeze, there is no air flow within the room because of equal pressures in the areas adjoining the openings. Now consider Situation B, which is exactly the same as A except that some landscaping elements have been added. On one side there has been a hedge added which builds up the pressure, while on the other side a hedge has been added to create a relatively low pressure. And, of course, the air will flow from the high pressure area to the low pressure area.

has the creativeness and versatility to design systems of heating and lighting to be the enveloping shell itself. And he does not limit himself to just one pet system. He works in all of the mediums of heat and light. In one school he devised a heating and a lighting cove combination. In another school he helped design an integrated artificial and natural lighting system. In still another he installed convectors in the air space of a brick cavity wall as part of an integrated heating system. He has used the space between ceiling joists for air ducts, as well as space underneath the floor. His philosophy is integration. Hall says that the trouble with most architects is that they call their engineers in too late. They design these glass schools without giving thought to how they are going to be lighted and heated; then they call in the engineer. "It is like trying to hide a tractor in a fruit jar."

Nothing will be said about the merits of hot air systems versus steam radiation, or hot water panels versus unit ventilators. The pages of this book will probably be yellowed by the time engineers and architects stop debating the question (or arguing the merits of the incandescent lamp versus the fluorescent one.) This book takes the stand that regardless of the system of heating—hot water panels, steam or hot water radiation, unit heaters or unit ventilators, or what have you—the important thing is the way it is engineered and the way it is integrated into the envelope. The same applies to systems of lighting. It is not so much what you do in this case. it is how you do it.

THE GREAT NEED FOR RESEARCH FOR ENVIRONMENTAL CONTROLS

This chapter about the environment should not end without a word about the need for research. In one sense of the word, "research" means finding answers. The research described here provides answers to a number of questions concerning environmental controls, but many other questions remain unanswered, indicating there is much research yet to be done before the envelope can be designed properly for maximum comfort for the pupil. Nevertheless, after having carefully studied the contents of this chapter, today's school planner should be equipped with enough answers to help him design better school buildings.

The writer has been very careful to stay clear of rigid formulas and set standards. There are too many restrictions that confront school planners now—outmoded codes, preconceived ideas of how a school building should look, limited budgets, and bureaucratic controls. Rigid formulas or standards concerning environmental controls added to these would only make the situation worse. The architect who has the responsibility of designing schools must be given a free hand to develop inprovements in school design. The research described here should offer such freedom. It has been proved that the so-called "standard" 24- by 30-ft. classroom with the 12-ft. ceiling can be done away with. For economy's sake the ceiling can be lowered. For education's sake the depth can be made greater. For the child's sake the classroom can be made more comfortable. This kind of research opens up completely new avenues for design. It shows that there are innumerable ways of designing the envelope. It argues that there is not and never will be an "ideal" solution, and that there should never be another "standard" classroom or any other part of the envelope.

Buford L. Pickens, an authority on regional architecture, sums up the situation like this:

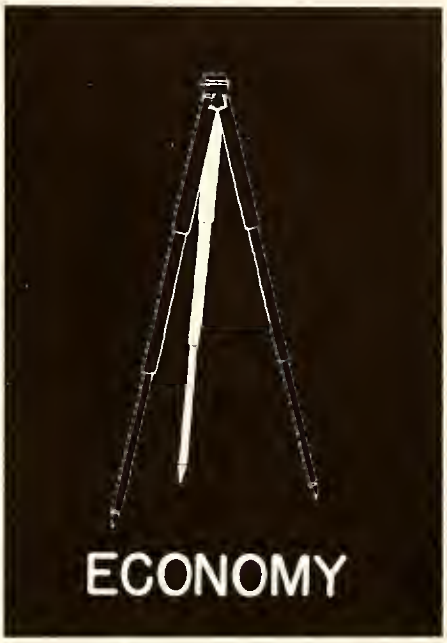
> After years of adapting warmed-over building designs, architects today are able to use the basic principles of built-in environmental controls. Scientific research applied to architecture has exploded the notion, one prevalent, that a house or school building which works well in one part of the country, let us say Michigan, would be equally successful if copied in another part, such as Lousiana. Unlike the motor car, which is designed to move north, south, east and west, buildings cannot logically or economically be reduced to the same kind of universal types. Being fixed to one spot for its entire lifetime, the building must reckon with the site, with the surrounding topography and with the regional climate. Even within short distances, a change in the external conditions may alter the building details which are needed to control ventilation, light, temperature, and sound.
>
> The facts concerning environmental controls are most important to the school for the reason that the school building directly affects the lives of most human beings; it is here that all our future citizens, during their formative years, work, play, live and learn. And just as the school building itself creates the environment which influences people in it, so too the climate and local topography set up the conditions which vitally affect the building. Until recently the architect could only guess at the way his school design would harness nature's fluctuating elements. Research is gradually taking the guesswork out of school building design.

Research plus imagination—that is what we need to get better envelopes to house our children and their education. Research can go a long way in improving this envelope that we are talking about, but it takes a creative architect and engineer to use it most effectively. If we continue to progress the way we have these last few years, one of these days we are going to design envelopes that at least will not get in the way of the educating process and the mental and physical development of our children.

CASE STUDIES WHICH ARE RELATED TO CHAPTER 3

No.	*Problem:*
1	How effectively can the space created by parallel open-corridor classroom wings be utilized in the educational program?
4	Can a double-loaded corridor school be ventilated by natural means?
15	Can a double-loaded corridor school have adequate natural ventilation as well as natural lighting?
16	How can adequate daylighting and natural ventilation be provided in extra width classrooms in a double-loaded corridor school?
17	How can bilateral lighting and cross ventilation be obtained in a multi-story classroom building?
19	Can natural lighting be facilitated by plan-layout?
23	Can a two-story school be planned for high level, evenly distributed natural lighting as well as a one-story school?
27	Can "back-to-back" classrooms be designed for proper natural lighting and natural ventilation?
30	How can cross-ventilation and bilateral lighting be provided in double-loaded corridor type classroom arrangements?
32	Can low budget gyms be lighted by natural means effectively?
37	Can bilateral lighting on a double-loaded corridor arrangement be provided at low cost?
39	How effectively can artificial and natural lighting be integrated?
40	Can bilateral lighting be achieved for multi-story classroom units?
43	Can good natural ventilation be accomplished in both summer and winter?
44	Can outside space be arranged to facilitate classroom activities?
45	Is it necessary for classrooms to have high ceilings generally required by codes?
47	Can a compact plan arrangement be made without sacrificing natural lighting and natural ventilation?
48	How can controlled lighting be achieved on east and west fenestration?
51	Is a semi-outdoor school feasible?
62	Is a quadruplex classroom arrangement feasible?
63	Can the advantages of outside and inside swimming pools be combined?
64	What kind of a layout is suitable for an area of heavy rainfall?
69	What is a practical method of audio-visual blackout for standard classrooms?
70	How can appearance and scale of double-loaded corridors be improved?
76	How can the use of the classroom be freed from restrictions imposed by daylighting?
85	What is one way to darken a classroom for the projection of pictures with the least amount of effort and time?
86	What type of light fixture can be used with low ceilings?
87	Are the requirements of flexibility and economy compatible?

CHAPTER 4 ECONOMY AND THE SCHOOL PLANT

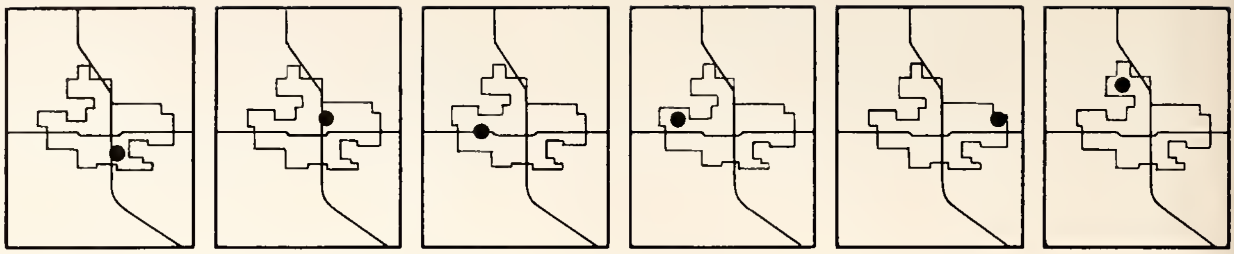


93. The last leg of the tripod is economy, and the length of the leg depends on how much money is available for the building program. Invariably, after programming is complete, school planners find that this third leg is very much shorter than the other two. This leaves two alternatives: (1) to get more money, or (2) to make certain compromises in educational and environmental requirements. Unfortunately, the second alternative is the path that school planners must take. Sometimes such compromises result in mediocrity, but if the school planner has imagination and skill, he can substitute a "happy balance" for "undesirable compromise." He can do this only through a simultaneous consideration of all three factors —education, environment, and economy.

There is a big difference between low cost schools and economical schools. The term "low cost" has a limited meaning, referring only to the relative price of the plant. The term "economical," on the other hand, is much broader and refers to the management of the means and resources of a community with a view to productiveness and avoidance of waste in both the planning and the operation of a school plant. A school, for example, that cost $10.00 a square foot usually is low cost, but it might not be at all economical. If the low unit cost figure is obtained at the expense of the educating process as explained in the second chapter, or at the expense of a healthful and stimulating environment as discussed in the third chapter, or at the cost of exceedingly high maintenance, the school is certainly not economical. Economy as a planning factor is concerned just as much with the pupil, education, and the environment as with the fabric of the envelope.

ECONOMY AND ARCHITECTURE

We have already discussed the Trinity of School Planning. It was asserted at the end of Chapter 1 that a good school is one that achieves a trilateral balance among the three factors of planning—education, environment, and economy. It was pointed out that this interrelation could be visualized as an imaginary tripod having adjustable legs which represent each of these three main factors. Change the label on the function leg from "education" to "liveability," and the tripod represents the Trinity of House Planning; change it again and yet again, but always one of the three primary factors is "economy." If an architect designs the most livable house in the world and manages to house these living activities in a structure designed for maximum eye appeal and for top efficiency as far as light, air, and sound are concerned, is the result of his endeavor a successful example of good architecture? Not if he



E L E M E N T A R Y S C H O O

LINCOLN

	CLASSROOMS	CAFETERIA	AUDITORIUM	GYM	KINDERGARTEN	COST ESTIMATE
EXISTING	13	1	1			
1950						
1955						
1960						
1965						
1970						
TOTAL						

JEFFERSON

	CLASSROOMS	CAFETERIA	AUDITORIUM	GYM	KINDERGARTEN	COST ESTIMATE
EXISTING	14	1	1			
1950						
1955						
1960						
1965						
1970						
TOTAL						

E. FIELDS

	CLASSROOMS	CAFETERIA	AUDITORIUM	GYM	KINDERGARTEN	COST ESTIMATE
EXISTING	10					
1950	convert 4 classrooms into cafeteria-assembly 1					20,000
1955						
1960		abandon				
1965						
1970						
TOTAL						20,000

UNIT ONE

	CLASSROOMS	CAFETERIA	AUDITORIUM	GYM	KINDERGARTEN	COST ESTIMATE
EXISTING						
1950	8					120,000
1955	4					60,000
1960		1			1	20,000 35,000
1965			1			50,000
1970	4			1		60,000 50,000
TOTAL	16	1	1	1	1	395,000

UNIT TWO

	CLASSROOMS	CAFETERIA	AUDITORIUM	GYM	KINDERGARTEN	COST ESTIMATE
EXISTING						
1950	5					75,000
1955	5					75,000
1960	2	1				30,000 35,000
1965			1		1	20,000 50,000
1970				1		50,000
TOTAL	12	1	1	1	1	335,000

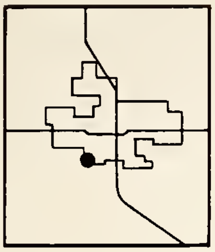
UNIT THREE

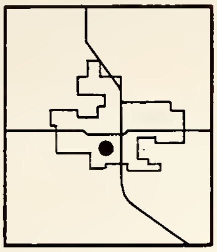
	CLASSROOMS	CAFETERIA	AUDITORIUM	GYM	KINDERGARTEN	COST ESTIMATE
EXISTING						
1950	4					60,000
1955	8					120,000
1960	4					60,000
1965		1			1	35,000 20,000
1970			1	1		50,000 50,000
TOTAL	16	1	1	1	1	395,000

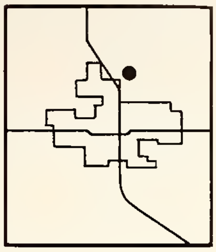
94. Not only is it important to set up budgets for current building programs, but it is even more important to develop a budget for future years. This chart taken from *Your Schools*[28] gives the over-all picture of a long-range financial plan for building schools in Stillwater, Oklahoma. The plan is the result of a survey of school-building needs conducted on a community-wide basis under the leadership of Superintendent R. R. Russell and a steering committee of the local Chamber of Commerce. Architect Philip A. Wilbur suggested the condensed version of the financial plan as illustrated here. Note that this chart contains (1) the names and locations of each existing school, (2) facilities at these schools, (3) the location of proposed schools (Units one

bankrupts his client! So it is in educational architecture.

Educational architecture is shaped by economy; in this day there is no doubt about it. A school district has just so much money and that is all. And the architects must work within the limited boundaries of the tax structure. This does not mean that that is right, for the tax structure can, in some cases, be completely out of line with the real needs of the community. For example, does it make sense for us as a nation to be paying more money for liquor than we are for education? But whether we as school planners like it or not we are faced with a limited pocketbook to build our schools, and our goal today must be to build economical schools. Ernest Langford and Arthur Melloh sum it up in a nutshell when they say, "Taxpayers and educators alike are interested in having school plants which provide a healthy, cheerful atmosphere conducive to learning—plants which also serve to inspire conscientious, capable teachers in their task of training the young people of our American communities, large and small. The re-







L S

HIGH SCHOOLS

UNIT FOUR

	Classrooms	Cafeteria	Auditorium	Gym	Kindergarten	Cost Estimate
Existing						
1950						
1955						
1960	7					105,000
1965		1				35,000
1970	5		1	1	1	75,000 50,000 50,000 20,000
Total	12	1	1	1	1	335,000

WASHINGTON

	Classrooms	Cafeteria	Auditorium	Gym	Stadium	Shops	Cost Estimate
Existing	10	1	½	½		1	
1950							
1955	abandon frame part of plant. rebuild and modernize entire building.						205,000
1960							
1965							
1970							
Total	12	1	½	½		1	205,000

JR. HIGH

	Classrooms	Cafeteria	Auditorium	Gym	Stadium	Shops	Cost Estimate
Existing	12	½	1	1			
1950							
1955							
1960							
1965	abandon						
1970							
Total							

SR. HIGH

	Classrooms	Cafeteria	Auditorium	Gym	Stadium	Shops	Cost Estimate
Existing	30	½	½	½	1	1	
1950							
1955	6 buy site for new school						120,000 30,000
1960	12						240,000
1965	convert senior high into junior high and build high school at new location.						1,000,000
1970							
Total							1,390,000

	COST	AVAILABLE FUNDS
EXISTING		
1950	275,000	272,666
1955	610,000	620,253
1960	525,000	608,365
1965	1,210,000	1,200,000
1970	455,000	500,000
Total	3,075,000	3,201,284

through four), (4) a listing of facilities to be built for each school for 1950, 1955, 1960, 1965, and 1970, (5) an approximation of cost of construction of these new facilities, (6) a summation of total cost for each school and for the entire system throughout the long-range building program, and (7) an estimate of available funds to meet these construction needs. It should be remembered that long-range plans must be revised year by year, that estimates must be changed as additional information is gained. To some it may appear a waste of time to project school needs so far in the future, but experience has shown that planning for the future will pay big dividends provided such planning is a continuous process.

quirements of 'adequate school plants' and 'most for the dollar' are not incompatible if preceded by careful planning on a community-wide basis."[28]

NEED FOR ECONOMICAL SCHOOLS

Do we really appreciate this necessity for economical school plants? We have been talking about the overcrowded condition of our schools in this country since before the Second World War. We have talked through more than a decade of increasing population and record birth rates. We have talked too much, for while we talked those children born during and just after the war inconsiderately went about their own business of growing up and began entering already overcrowded schools.

What are we doing now? Oh, we are building a little here and there, but mostly we are still talking. And while we are, elementary school enrollments are increasing at a rate of a million pupils per year. They will continue to do so, according to most census authorities, until 1960, and probably long after that. This surge

will begin to burst our already swollen high schools after 1960.

The children are here, and more are coming fast, and they present a problem we have got to meet now with action, not with words. If we do not, they simply are not going to stay in school and struggle under hostile conditions. The U. S. Chamber of Commerce[29] tells us that right now only about half of the fifth graders finish high school, and far fewer than that are graduated from college. This adds up to an incalculable loss of human productivity, efficiency, and ability to prosper socially and economically.

The need for more school plants is, of course, only a part of the total need, but that part has been so obvious in the seven states with the greatest population gain (20 per cent to 50 per cent gain since 1940) that they have actually got around to building schools in something like a real building program. The rest of the states are building only spasmodically, and all are actually making the problem worse in several ways.

The most obvious of these is the practice of postponing building programs. Upset by the high level of prices and harassed by the difficulty of getting materials which go first into the defense effort and sometimes go nowhere at all because of labor-management feuds, people are inclined to wait. How long they intend to wait, they do not know. They have no assurance that the situation will ever get better in their lifetimes, but they wait because it is easier. The difficulty with this is that the needs of the children do not wait; they grow as enrollment increases. And the delinquent community's human crop failure grows larger proportionally. Local street improvements and the new courthouses can wait, maybe; new race tracks and drinking and gambling places can certainly wait. New schools simply cannot wait; their importance to the future of the community and the nation is far too great.

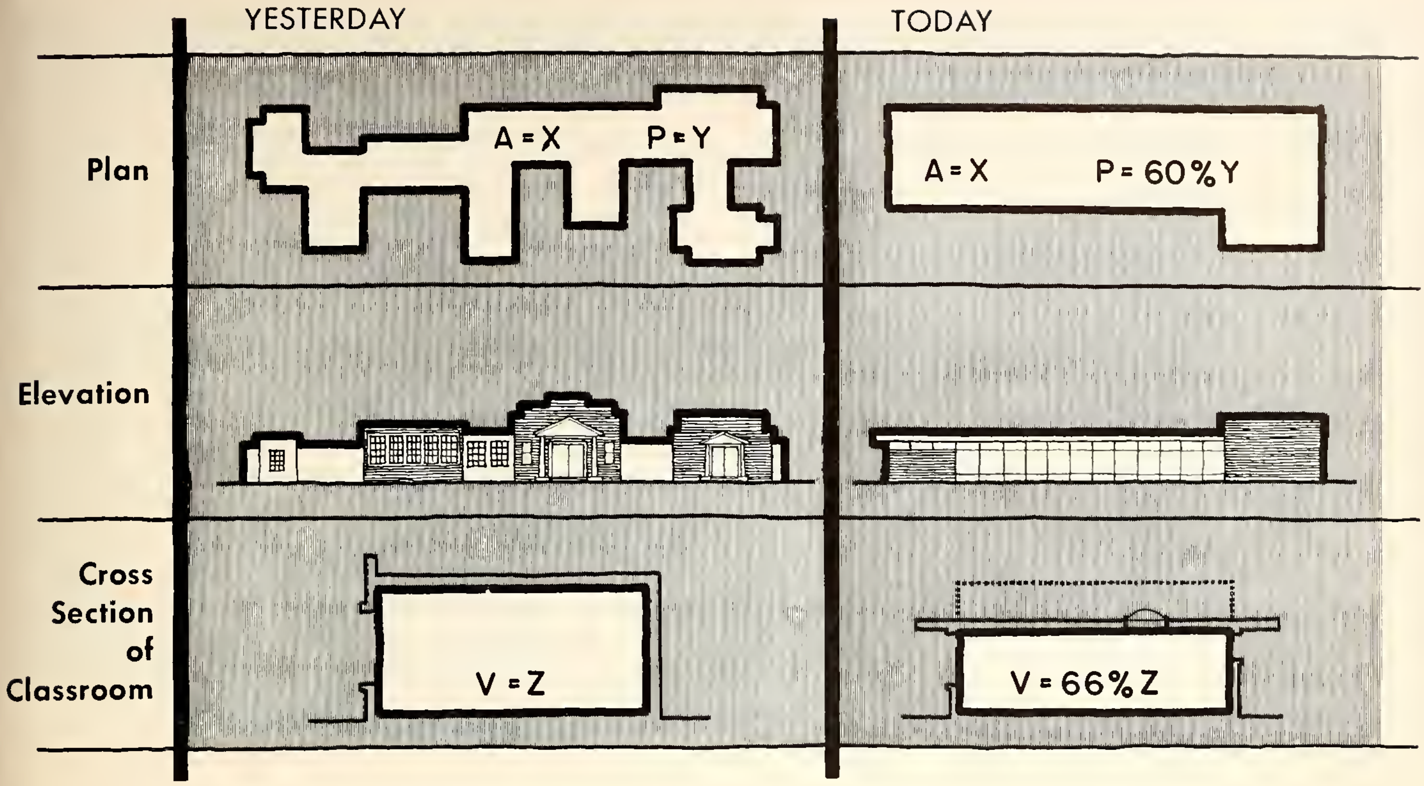
The second major way in which we interfere with our own necessary building programs is our financial attitude. Our dislike for paying school taxes is all out of proportion to our desire to provide for our children. In post-war California, for instance, "a survey of state school needs by the California Teachers Association indicated approximately $450,000,000 was needed to finance new construction to house properly the increase in school enrollments from kindergarten through the high school grades. However, during the many hearings . . . the legislature decided that politically such a large amount would not be voted by the people of the state. Further, because of pressure from some of the larger cities, the recommended square feet per pupil on the elementary level was arbitrarily reduced from 70 sq. ft. per pupil to 55 square feet per pupil. The $450,000,000 was correspondingly reduced to $250,000,000." This information is from a report, "Changes In Present Regulations Necessary to Make State Aid for Capital Outlay Practical for Secondary Schools," by Henry L. Wright, Chairman of the Education and Research Committee of the California Council of Architects, and one of the nation's great school architects. Neither Architect Wright's purpose nor our purpose in quoting this material was to castigate the legislature of the state of California. As a matter of fact, California, one of the states enjoying the greatest population increase in the last decade, is doing a school building job second to that of no state. Those legislators were simply realistically aware of their people's aversion to school taxes. Their method of reducing the capital outlay by an arbitrary reduction of the space requirements per pupil is a matter to be discussed later, save for a general comment that it insured an inadequate educational experience for thousands of junior and senior high school students, particularly in the smaller schools. The blame rests with the people themselves, and California's people are not any worse than those of any other state. It is time we all decide, however reluctantly, that if we really want our children to have what they need, we have got to pay for it.

We undermine our necessary building programs also by limiting the bonded indebtedness of each school district in most states. In Texas, for example, the limit is 7 per cent of the total assessed valuation of the school district. In Illinois it is 6 per cent, in Massachusetts it is 3 per cent, and in Indiana 2 per cent. There is no question but what in general this is a wise policy. But there is a question whether each limit is the maximum allowable under sound policy. And there is a greater question whether the limits should be so inflexible. It takes almost no imagination to visualize specific situations in which both the paramount needs and the general prosperity of a district or a state would justify an adjustment of that area's imposed limit.

Furthermore, there are always some districts which do not have sufficient taxable wealth to provide funds for adequate building programs. The needs of these districts are very real, and they are important, not only to the districts, but to the entire state. Clearly these districts must have additional support.

The urgency of this problem is easy to recognize, but the people generally seem so afraid of the goblins of the "welfare state" that they have a tendency to distrust all forms of aid from any source. The plain fact is that the federal government is not, and never has been, interested in taking over control of the public school system through fiscal aid. The Committee on Education of the U. S. Chamber of Commerce makes this quite clear in a little booklet (cited earlier in this chapter) called the *Growing Challenge*. In this booklet the U. S. Chamber of Commerce draws a convincing argument showing that from 1920 to 1948 federal taxes increased three times as much as local and state taxes combined and that the federal debt grew four-

How Geometry Affects Costs



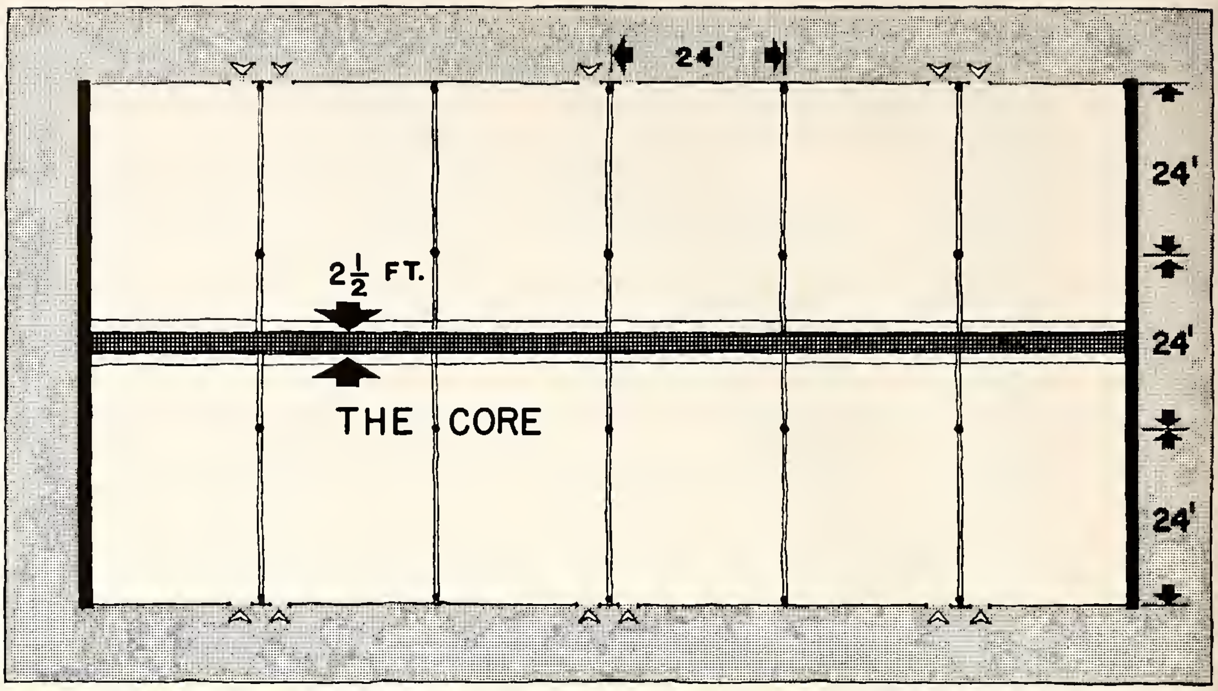
95. These sketches show that there is a definite relationship between geometry and construction cost. The left vertical column shows plan (a), elevation (b), and classroom cross-section (c) of an old fashioned school. The right vertical column shows corresponding sketches of a more up-to-date school. First consider the plan. Although both schools have exactly the same area, the newer type school has only 60 per cent as much outside wall area as the other. Next consider the silhouette of the elevations. One has sixteen roof breaks in comparison to only one roof break for the other. And next consider the classroom cross-sections through a technique of tri-lateral lighting. The volume of the new school is only two-thirds that of the old school.

teen times as high as local and state debts combined and concludes emphatically that the state and local levels are obviously the levels that can best provide the additional support necessary for adequate school building. Of course, if the people are not willing to assume their responsibilities on the state and local levels, the federal government inevitably will have to. The danger lies far less in a wilful, power-mad federal government, than in an abdication of individual responsibility. Recognizing this, several states do offer aid to their poorer districts. but many other states seemingly prefer to accept an ill-trained, maladjusted rising generation out of some of their districts until such time as the federal government is forced to assume their responsibilities.

It seems clear that if we are going to build the schools we so obviously need, we are going to have to do it with materials that are both scarce and costly; we are going to have to appropriate the necessary funds; and we are going to have to assume full responsibility for what we must do. And all of this, just as clearly, is going to cost money, more money than we like to spend. It is, therefore, imperative that everyone proceed with the determination to spend no more than necessary, to insure that the long-suffering taxpayer gets the most for his dollar.

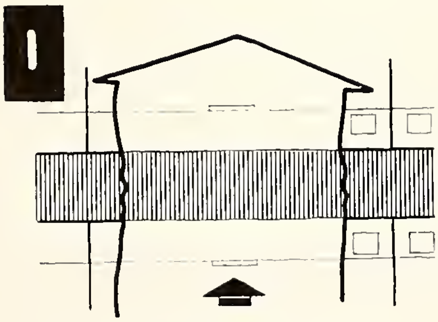
SETTING UP COST CONTROLS

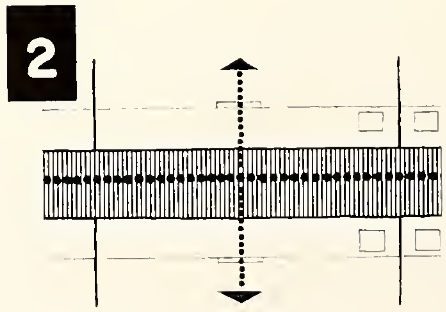
How can we get the "most for the dollar"? One of the first things to do is to set up cost controls. There has probably never been a community which has had enough money to do all of the things it wanted to do. And since there is not enough money to do everything, there must be some sort of plan to do the most for the pupil and his education process with the money available. Let us see how this works. Jonesville, a medium size community, has great need for three new elementary schools and a junior high school. Because of the tax limitations set up by state laws it can vote only $1,500,000 in bonds. There are no reserve building funds, so this figure must cover everything from the cost of sites to the cost of furnishing. The architects have already been selected because they are the logical ones to determine whether the cost of construction of these four schools has a chance to come within the money available if the bonds are passed. And of course

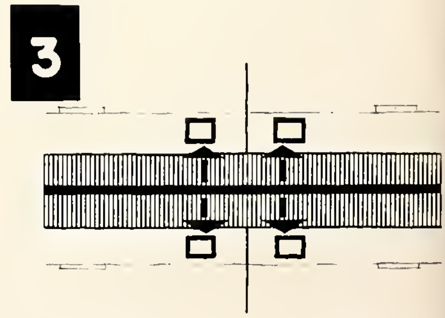


the educational needs have already been determined and the space requirements for each school enumerated. This situation now is this. On one side of the ledger Jonesville needs so much space (and of course this space must be the right kind as far as the environment is concerned), and on the other side of the ledger the community will have just so much money. The needs must balance the pocketbook. The next step for the school planners of Jonesville is to set up the initial breakdown, or the budget, of funds which may be allocated to the building program. In this case the total amount to be spent is definitely fixed. There are other fixed conditions. It has already been determined that the sites will cost approximately $70,000. The architect-engineer fee will be 6 per cent of the total cost of construction. The planners have found that on similar jobs the equipment cost runs close to 10 per cent of the construction cost. With these figures in mind the plan-

Functions of the Core







97. The first function is to facilitate *air flow*. This is done by a system of staggered baffles. See cross section of CORE in Case Study 87. The air flows across the classrooms on the windward side, then through high inlets on the Core, and out low (desk high) openings into the classrooms on the leeward side. See air flow tests.

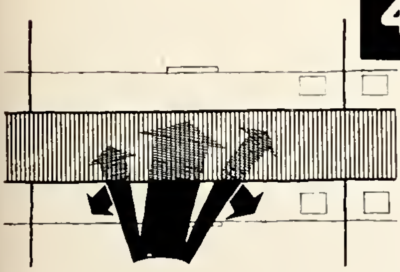
The second function is to provide *electrical* service to the classrooms. The supply lines are installed down the Core with fingers to classrooms on both sides of the Core, affording easy maintenance, but still better, offering flexibility of electrical service.

The third function is to provide a plumbing layout which is economical and accessible for proper maintenance. The supply and drainage pipes run in the Core above grade. Notice the back-to-back plumbing fixtures. In essence, the Core provides a pipe tunnel above grade.

Back-To-Back Classroom Arrangement

96. Here is an example to show how the consideration of the geometry of the envelope led to the development of a unique classroom arrangement. The author again must draw from his own experience. In the early stages of planning schools for Laredo, Texas, the architects found that a system of back-to-back classrooms would achieve the greatest economy because of the savings resulting from eliminating some outside walls. After further studying the possibilities of geometric forms, the architects found that even greater savings could be made if the long ends of the classroom were placed inside, instead of being exposed to the weather, as is customary. By such an arrangement it was found that the exterior walls could be further reduced 18 per cent. See sketch. But of course the main problem was to devise some scheme by which the classroom could be ventilated and lighted. The lighting problem was solved easily enough by the use of plastic sky domes installed in the roof near the interior walls. The solution for ventilation was somewhat more difficult. After many schemes were tried, the final scheme resulted in a partition that would let air through but keep the sound out—in essence an acoustically treated air duct. The air flow from the window enters the windward classroom, flows across it into an opening near the ceiling and down through a hollow partition 2 ft. wide, and out through an opening at the living zone into the opposite classrooms, then through this leeward classroom out the window. This problem solving approach led to even greater economies—through the device which the architects call The Core. The Core serves the functions of the partitions in a back-to-back classroom arrangement and many more. There are six major functions, and these are explained in the following diagrams. Where are the savings? The pipe trench is above ground. Plumbing is back-to-back with all supply lines above grade. Electrical distribution is simplified. Built-ins are back-to-back. Heating units and supply lines are grouped. And last, but not least, consider the low maintenance factor of all utility lines afforded by this scheme.

ners prepared the breakdown, listing a tentative allocation of funds. They found that after all of these various items were accounted for, less than $1,200,000 was left for actual building construction. The problem was then put in the laps of the architects. Could these four school buildings be constructed for this amount? After a great deal of study of the problem the architects came up with this reply, "Yes, the four buildings can be constructed for this figure, but we must have some control over either the space requirements, or the quality of the structure and building materials." The other planners decided that the space requirements had been cut to the minimum and that the control would have to be made in quality of the fabric of the building and other factors which determine the final way it is put together. So with this in mind the planners set up the following cost control breakdown of the funds which might be available:



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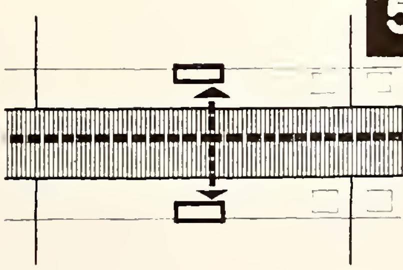
The fourth function is to *filter sound* between the back-to-back classrooms. The Core is acoustically treated so that there is at least a 35 decibel drop. It lets the air through, but filters the sound out. The sound transmission is about the same as in plywood partitions.



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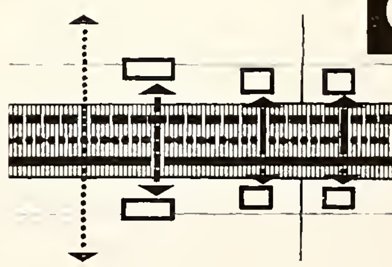
The fifth function is to provide a layout for *heating* these back-to-back classrooms. The heating supply and return lines run in the CORE and the heating units themselves are built into it.



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The sixth function is to provide *built-ins*. The Core includes all the built-ins, such as lavatories, sinks, and storage cabinets, thereby permitting the partitions perpendicular to the Core to be moved in any direction. By such grouping the Core allows for maximum flexibility.

PROPOSED BOND ISSUE	$1,500,000
Expenditures Expected	
1. Cost of Sites	50,000
2. Development and Landscaping of Sites (approx. 5 per cent of construction)	45,000
3. Equipment (Approx. 6 per cent for elementary schools and 10 per cent for secondary schools)	95,000
4. Elementary School "A"	160,000
5. Elementary School "B"	210,000
6. Elementary School "C"	180,000
7. Junior High School	615,000
8. Architect-Engineer Fee (6 per cent of construction)	70,000
9. Contingencies (5 per cent)	75,000
TOTAL PROPOSED EXPENDITURES	$1,500,000

This kind of tentative budget is set up prior to the bond election. If all goes well and the bond issue is passed, the Architect is in position to get down to establishing certain cost controls. He knows his approximate cost limits for each building. He knows approximately the amount of space that is needed. The only variables which he has to work with are such factors as the layout of the spaces and the structure and fabric of the building. Until he breaks these down, he cannot submit even a sketch, yet some school board members insist that renderings of proposed schools be published in the newspaper to show the people a "pretty picture" of what they are going to get when they pass their bonds. This "pretty picture" approach has no place in planning logical school buildings. The architect should not even think about a simple layout until the cost limitations are set. As we get further into this chapter we can easily see this. Certainly the architect cannot have the structure—concrete, steel, or wood—determined until he knows what the layout is. And he certainly should not know what the materials of construction will be either. If he does, he is not an architect, he is a magician!

Cost controls start with setting the limits. The trick is to work within these limits. It takes a well-informed and creative architect to do this, and he cannot do it by himself. He needs all the help from the educators that he can get. He might, for example, want to combine certain spaces in order to lower the construction cost, believing that such a combination would not greatly interfere with the educational program. But on all such decisions he should consult the educator. Any economies that might result from combinations of teaching spaces must be developed by architect and educator together, and a few such possible economies will be discussed later in this chapter. There are some economies of architecture, however, that are relatively independent of education. These include such items as the geometry of the envelope, the quality of the fabric, construction methods, and the type of structure. Let us consider them one by one.

GEOMETRY OF THE ENVELOPE AND COST

Does it make much difference so far as education is concerned whether the floor plan has a minimum number of breaks and corners? Or whether the silhouette of the roof line juts in and out? Or whether the classrooms have high ceilings? These geometric factors generally do not affect the educational program one way or the other, but they greatly affect construction costs of school buildings. The architect of the Jonesville schools who must work within a tight budget certainly should be interested in these factors.

First, let us consider the perimeter of a schoolhouse. It stands to reason that outside walls cost more than inside partitions. They are heavier, more insulated, more complex because they have to let in light and air, and they require much better materials to withstand the weather. Therefore it seems reasonable to expect that one way that we can cut down the cost of the envelope is to cut down the area of the outside walls. Refer to Case A of diagram in Fig. 95, p. 95. In Situation 1 we have a floor plan of a school with a floor equal to X. The length of the perimeter (P) is equal to Y. Compare the length of the outside walls of this school with the one shown under Situation 2. Because the building is more compact and takes on a geometric shape approaching a rectangle, the perimeter is only 60 per cent that of the other school, yet it has exactly the same area. If each of these schools has similar construction, there can be little doubt as to which one is the more expensive. The savings afforded by low perimeter schools also include a lower first cost of heating systems as well as lower long range maintenance—the greater the area of outside wall, the greater the heat loss. It is a good rule, therefore, (but one that the architect author will probably break many times in trying to achieve other effects and even other economies) that economical buildings will be roughly rectangular, as nearly square as possible, with a minimum number of breaks and corners. This does not mean that all low perimeter schools are economical. Far from it. It simply means that here is one way to cut cost.

Consider another way which has to do with the geometry of the envelope. Pay attention to the geometry on the vertical plane. If the silhouette of a school building juts up and down, it can be reasonably certain that every break in the roof rings the cash register for added construction cost. Breaks like these cost money at the time of the letting and even more as years go by. Every time there is a break in a roof whether it is caused by a parapet wall (referred to by the trade as the "cancer of a schoolhouse"), a clerestory, or simply a small building mass butting up against a large building mass, there is a flashing problem. Flashing is ex-

pensive and most of the leaks occur through the flashing; so buildings with simplified roof lines prove more economical not only at the letting but also throughout the life of the building. Now look at Case B, Situation 1. Here is a school with 16 roof breaks. Compare this with Situation 2, which has only 1. Which is the more economical as far as roof construction and roofing is concerned? The answer is obvious.

A third factor relating to the cost of the envelope concerns the volume. We have said that economy has to do with the elimination of waste. High ceilings represent one of the most notorious wastes of school planning, and the sad fact of the matter is that they have been sanctified by a great many building codes. This has already been discussed under the heading of natural lighting, but it more appropriately belongs here under economy. Let us consider the typical classroom. It has already been proved, in the preceding chapter, that high ceilings are not necessary in most cases for lighting. Most architects agree that low ceilings, because of their intimate effect, are better from the standpoint of architecture than are the customary high ones. Educators certainly do not advocate high ceilings because teachers cannot teach in the upper four feet of the classroom space. Now consider Case C, Situation 1. Here is a cross-sectional diagram of the so-called typical classroom with its 12-ft. ceiling. Let the volume (V) equal Z number of cubic feet. By lowering the ceiling to 8 ft. as in Situation 2, the volume is decreased to 66 per cent of the volume of the typical classroom. This reduction in volume does not compromise education in the least. And it does mean savings in construction cost. For Case Studies relating to geometry and cost refer to 6, 14, 41, 47.

THE FABRIC OF THE ENVELOPE AND COST

One easy way out for the architect of the proposed Jonesville schools is simply to cheapen the fabric of the envelope. He could specify a 10-year roof instead of a 20-year roofing, wood decking instead of concrete, light weight hardware instead of heavy-duty material, wood instead of brick, and so on. This does not take much imagination and certainly takes only a little effort. But it is the right way to cut cost? Is it the economical way? Let us get down to cases and find out. Consider not only first cost, but maintenance cost. And maintenance should mean everything from janitorial supplies to replacements and repairs, to insurance rates.

Let us take an everyday situation that most school planners have been confronted with at one time or another. Should the outside walls be made of brick, wood, concrete block, stone, architectural concrete, or stucco? The question is always asked in terms of what the community can afford. The novice school planner, unfamiliar with construction cost, generally concludes that the exterior wall material is the item that cost the most. And he is far from right. For the purpose of this discussion let up compare only two of the materials mentioned—say wood and brick. After an investigation of today's market, let us say that we have found that a good exterior wood siding which, by the time it is laidup and painted, costs somewhat less per square foot of surface than brick. Should our investigation stop here? What about insurance rates? Can the long-range savings in premiums for a brick school offset the first cost savings by using wood? Over the life span of the building, how many times will the wood siding have to be painted? Until we get these figures we really should not make up our minds which is cheaper in this case—wood or brick.

Let us assume we got the figures and found out that one was cheaper than the other. But how much difference does it really make? How much do exterior walls in schoolhouses cost in comparison with other items of construction? When we investigate this item, we are going to be surprised. Consider the construction analysis for a large consolidated school recently constructed in Albany, Texas. It is an all-brick school with classrooms having exterior walls of brick inside and out, with a windowless auditorium of masonry walls, as well as with a gymnasium. Here is what the contractor said the school cost, item for item. These figures are in terms of materials in place.

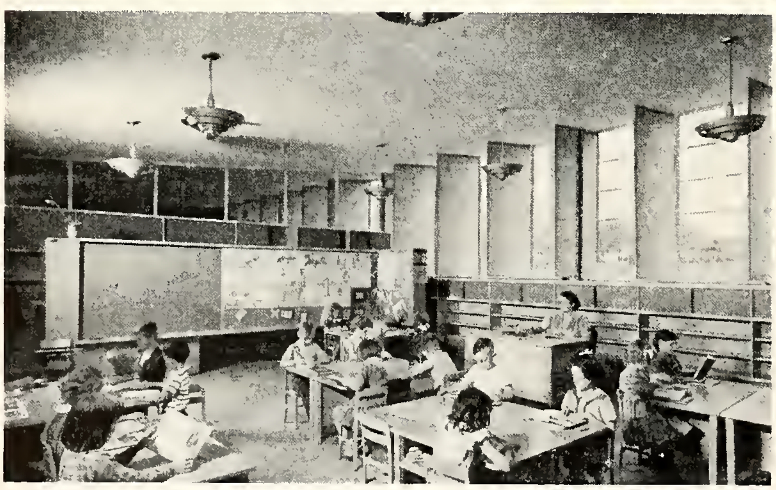
1. Setting up construction office, insurance, and bonds	$ 5,518.00 or	1.3%
2. Excavation, grading, and general earthwork	15,642.00 or	3.6%
3. Concrete floors, footings, and beams	18,895.00 or	4.3%
4. Formwork	6,270.00 or	1.4%
5. Sidewalks, curb, driveways, and misc. concrete	6,566.00 or	1.5%
6. Damp-proofing	1,725.00 or	.4%
7. Masonry (including tile in locker room and kitchen)	62,542.00 or	14.3%
8. Steel columns, beams, joists, trusses, and misc. iron	69,871.00 or	16.0%
9. Rough carpentry	30,983.00 or	7.1%
10. Millwork (including louvered ceiling and built-ins)	42,172.00 or	9.7%
11. Tackboard and chalkboard	5,047.00 or	1.2%
12. Acoustic tile	1,524.00 or	.3%
13. Cement asbestos board (classroom ceiling and coverwalks)	8,932.00 or	2.0%
14. Asphalt tile and linoleum	5,159.00 or	1.2%

98

99

Fabric

98-102. The selection of the fabric of a building is an important factor in final construction cost. Here are examples of economical use of materials. By the simple use of a prefabricated ceiling—roof deck laid over exposed beams (98), not only economy but also very beautiful and honest architecture can be achieved. The second photograph (99) shows a similar combination. The use of large construction panels which require no maintenance (100) affords low first cost as well as low long-term cost. Glass, plywood and cement asbestos fabrics are finding their way more and more into schoolhouses for cost reasons (101). Even expensive materials such as marble panels can bring about economy if used properly. The lower photograph (102) shows a marble wall, an economical use of a high quality building fabric. (See Case Study 90.)



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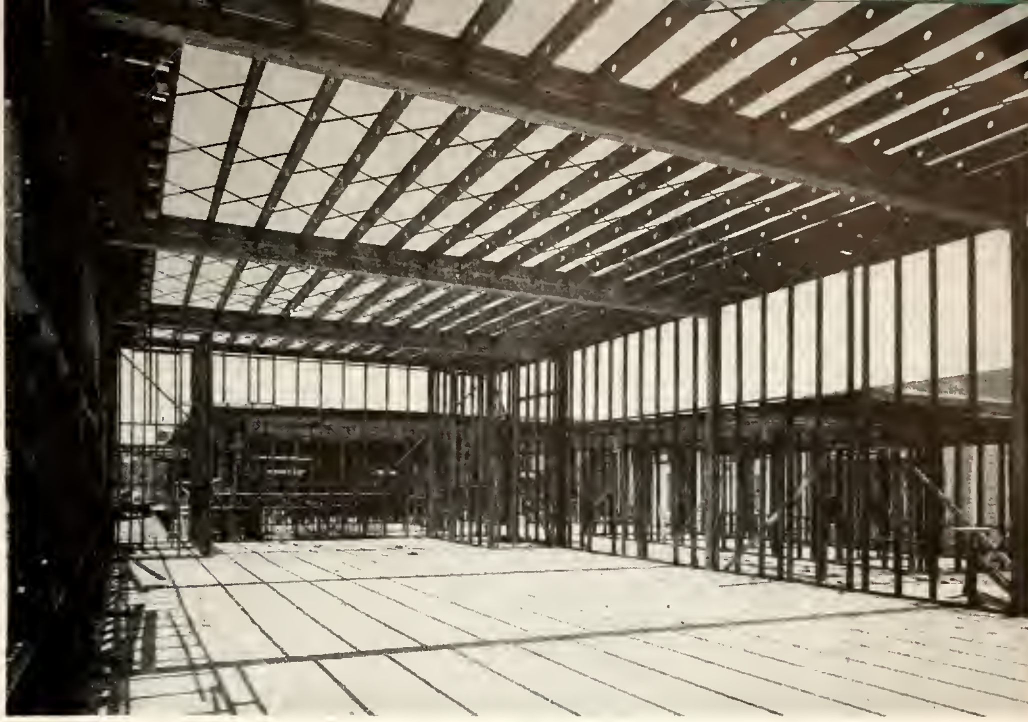


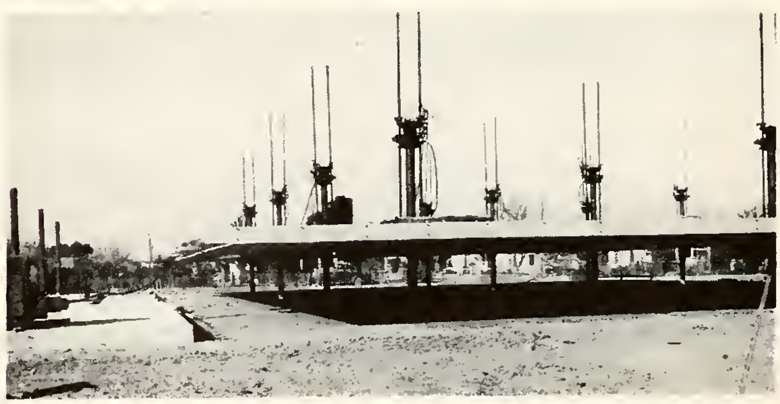
103

Structure

103-107. The structure over which the fabric is placed also plays a great part in balancing the construction budget. Here are six kinds of structures familiar to most architects. The first is a commercial steel frame system (103). The next (104) is a rigid steel framework which makes use of standard beam and column sections found in every steel mill. The middle photograph (105) shows a concrete frame building. The next photograph (106) shows a composite use of steel and wood; in this case the wood beams are built up of laminated sticks of lumber. The last photograph (107) shows the recently developed lift-slab structural system (Case Study 87) which achieves economy through the elimination of expensive form work.

104

105



106

107

15. Roofing and sheet metal	24,617.00 or	5.6%
16. Poured gypsum deck	14,454.00 or	3.4%
17. Metal bucks, toilet stalls	1,814.00 or	.4%
18. Steel sash, glass, caulking	18,641.00 or	4.3%
19. Painting	9,300.00 or	2.1%
20. Hardware	4,148.00 or	.9%
21. Folding tables, backstops	4,217.00 or	1.0%
22. Electrical work	20,940.00 or	4.8%
23. Plumbing and heating	57,540.00 or	13.2%
	$436,817.00 or	100%

Note that all masonry work of this school, including the tile in the locker and shower rooms as well as the kitchen, totaled only 14.3 per cent of the total cost of construction. If the tile were subtracted, this figure would run as low as 10 per cent. And because of the large masonry mass of the auditorium and gymnasium this school can be classified as "heavy" on masonry. This is an analysis of one school for the cost of exterior walls. Consider some more. In a high school in Calallen, Texas, the exterior brick walls cost about 9 per cent, and this included a large gymnasium. The large brick mass consisting of the windowless gymnasium and auditorium of the new high school at Norman, Oklahoma (previously mentioned in Chapter 2) cost less than 19 per cent of the total construction of these two units, while the brickwork classroom wings cost less than 5 per cent. The brick walls of a small elementary school in Elk City, Oklahoma, came to only 6.7 per cent, and the brickwork in three elementary schools in Laredo, Texas, averaged less than 4 per cent of the total cost of construction. The average for the cost of brickwork in place in 15 brick schoolhouses analyzed by the writer was approximately 8 per cent. So if we think of the fabric of the envelope as being the outside solid walls, we are thinking only of about 8 per cent of construction cost. If our analysis proved that wood in the long run was 10 per cent cheaper than brick (that is, if wood were used instead of brick), we would realize a savings of only about .8 per cent of construction cost. The example presented here is not an argument for brick over wood. It is presented to show the value of a careful analysis covering each building material which goes to make up the fabric. In large building masses such as auditoriums and gymnasiums, the use of wood, tile, or concrete block in lieu of brick may prove more economical, but in the classroom wings, because of the large glass area involved, the walls are relatively unimportant as cost controls.

Architect Don Barthelemc, one of the more creative architects of the nation, designed a prize winning school in the Houston area using marble as an economy measure. Large sheets of marble were set in simple steel frames and required minimum labor to install. These marble walls had their built-in color and finish for both outside and inside surfaces. Even expensive material, if properly used, can be economical. See Case Study 90.

Sometimes leaving off materials may prove expensive in the long run[30]. There is a case of a small country school in East Texas in which, because the bids ran high, the asphalt tile flooring had to be omitted from the concrete. In three and a half years the school district could have paid for the flooring by savings in wax which was soaked up by the porous concrete. On the other hand, there is a tendency on the part of some school planners to overlap materials by such practices as putting large areas of chalk and tackboard over expensive plaster. In some cases it has been found more economical to have the finished wall itself be either tackboard or chalkboard. More discussion about interior walls will be found in the next chapter under the heading of vertical work surfaces.

To conclude this discussion of the fabric of the envelope, it can be said that economy will be achieved only through the consideration of all materials, not just one or two.

HOW THE STRUCTURE AND CONSTRUCTION METHODS AFFECT COST

School board members, who are responsible for school construction, but have little experience with it, sometimes find it difficult to distinguish between the structural system and the fabric of the envelope. Architect Eberle M. Smith explains the difference in these simple terms: "The structural system of a school building is the framework on which the enclosing envelope is draped. The building itself takes on the shape, size, and mass of the framework. No building can be better than the limitations set up by this framework will permit. A well-designed school interprets this framework, and an architect can tell almost at a glance at the exterior of a school just what the framework consists of."[31] Generally the structural system is spoken of in terms of (1) vertical supporting members—columns and load-bearing walls, (2) horizontal supporting members —joists, beams, trusses, and sometimes foundations, and (3) decking—floor slabs and sheathing and roof decks. The basic materials for structural members are concrete, steel, and wood. All have their advantages and disadvantages. Some architects favor one over the other because of local conditions such as availability, workability, and labor conditions. No doubt there are desirable situations for each material—even for combinations of them.

The economy of structures comes about through very careful engineering. Any architect or engineer can make a building too strong. But it takes imagination and keen judgement on the part of these men to design structures to be just strong enough. Over-conservative designers who pad the factor of safety also pad construc-

tion costs. It is fine to know that we have a "hell for stout" structure, but if we get this excessive strength at the sacrifice of teaching space and equipment, it is wrong. Muscle-bound schoolhouses do not have economical feasibility.

What per cent of the total construction cost is taken up by the structure? Turn back a couple of pages and refer again to the construction cost breakdown of the school in Albany, Texas. The structure in this case is a steel frame system with large wide flange beams bearing on H columns, plus open web joists spanning the distance between the beams. The cost of all this structural steel in place, together with all reinforcing in the concrete floor slab, totals 16 per cent. This figure also includes the cost of steel angle window and door frames. It is estimated that the structure alone would not exceed 12 per cent. The structural steel for the auditorium and gymnasium of the Norman High School totaled less than 11 per cent. And that was a situation with very long spans. At Industry, Texas, the cost of installing steel columns and steel beams came to only 6 per cent. The structure of a new school at Elk City, Oklahoma, having steel columns and steel beams ran a little over 10 per cent.

The exact figure depends on the factors of the size and shape of the building, length of the spans, availability of materials, and the local labor conditions. But for the sake of this discussion let us assume that the structural frame where steel is used runs about 12 per cent of total construction cost. Let us also assume that wood is 25 per cent cheaper than steel (a purely arbitrary figure) and concrete (again purely arbitrarily) is 25 per cent higher than steel. That means that if one or the other were used in lieu of steel, the total cost of the job would vary only 3 per cent. We can conclude, therefore, that there is no one individual structural system nor single building material that will produce a low cost school building. The savings are accumulative. The architect and the contractor know this too well, particularly when they must lop off 10 per cent from an excessively high bid. A change of a material or of a structural method simply will not do the trick. Whittling half of one per cent here and one per cent there soon adds up. That is the way it is done to reduce the cost after an unsuccessful letting; that is the way it should be done during the planning stage. In choosing the materials and structure for the envelope, make every effort to predetermine the relative cost of each item.

The material of the structural system, whether it be of wood, steel or concrete, is certainly important as far as the cost factor is concerned. But equally important is the way it is put together. How much labor is involved in the operation? Builders tell us that today labor costs run nearly 60 per cent of the total cost of construction, while only a few years ago they were down to 35 per cent. Today, architects talk in terms of labor saving devices, speedy erection techniques, fewer and larger building products, and simplified construction details. This consideration for labor has been a strong force in shaping some of our new schools.[33] Let us consider a few of these items which affect labor costs.

Consider the structure itself. One way to cut down the cost of labor is to design the structure to have repetitive structural units. For example, a crew of workmen can put up 100 similar steel columns and beam frames in a much shorter unit of time for each frame than it would take if there were only five frames to erect; routine in building construction generally produces economy. For that matter the same principles work everywhere. Housewives know it well in their homes, and manufacturers send their new workers to school until they learn to handle their specific tasks efficiently and skillfully. School buildings are so complicated that there are thousands of little tasks involved; each new school generally requires new labor operations. The more different kinds of labor operations there are, the higher the cost of labor. Henry Ford found a way to whip that problem a long time ago. His solution? Build a great number of similar construction units so that the unit cost will be less. This same theory of mass production can be applied to school buildings. For example, one school constructed recently had 65 similar structural bays. Because of the simplicity of the design, each one could be erected with six identical operations. The structure, therefore, had 390 similar operations for its erection crew. This spells economy. Not only does the use of repetitive structural units mean savings on the job site, but other savings occur at the steel mill, if steel is used. It is a lot cheaper to cut 100 beams of the same shape, weight, and length than to cut 100 beams of various dimensions and weights.

Another way that economy can be achieved is through making use of larger and fewer units of building materials. If we stop to watch a carpenter put on the wood sheathing of a wall, we generally see that he works with boards 8 in. wide, plus or minus two inches. If he works in a space about 4 ft. by 8 ft. he has to handle and nail down about 12 to 16 different pieces. Would it not be easier, quicker, and consequently more economical if he were to use one large piece of fiberboard or plywood instead? In the long run it probably would be, even if the large sheets cost more money to cover the same area. The cost of labor would probably be reduced at a much greater rate than the rate of the increase in the cost of the building materials. For this reason schools today are being built with more large building units such as cement-asbestos sheets, fiber wallboards, gypsum sheeting and deck units, plywood, precast concrete floor and roof deck units, and steel wall and floor panels. Architects are doing everything they can to cut down high labor costs by using large building units.

Another way labor costs are being cut is by having fewer crafts work on the construction job. Waste of labor has occurred many times when the tile setter gets in the way of the carpenter, the painter waits for plasterers, or the concrete crew waits for the plumbers. Let us get down to a specific case, the installation of a simple door buck. The door is a typical interior door leading into a classroom. It has a wood frame. The wall surrounding the door consists of a tile wainscot with plaster above. Above the door there is a fixed glass. To install this simple item requires a carpenter, a brick mason, a tile setter, a glazer, and a plasterer, as well as the craftsmen who lay the flooring around the door. These various skilled workers cannot help getting in each others' way physically, to say nothing of their clashing politically. The author is reminded of a school construction job, which he helped supervise, where a strike was called by masons because the carpenters were laying a rough tile on each door buck to keep it in plumb. It pays to have a minimum number of different crafts on the construction job. Architects are not only designing buildings with fewer and larger construction units but also are developing details which require fewer crafts.

Machines are helping reduce building construction cost—machines like post-hole drillers that dig footings; machines that lift floor slabs, which are poured on the ground, up two or three floors; machines that tilt-up concrete walls which have been poured on the floor with a minimum of form work. Power tools also are coming into full play: Electric saws that require as little effort on the part of the carpenter to cut through a dozen two-by-fours as to cut through one two-by-four with a hand saw; gun-like hammers that shoot anchor bolts into concrete and steel; and stud welders that fasten wall board materials to steel frames the way ordinary staplers fasten papers together. When we see these machines on the construction job, we know that they are there to speed up the erection process.

The waste found on construction jobs these days is appalling. The familiar piles of sawed-off pieces of lumber, halves and quarters of wallboards, and ends of saw bricks represent many lost construction dollars. A lot of this waste, of course, comes through mishandling on the construction job, but a lot more comes from mishandling on the drafting board. Windows located so that bricks must be cut to fit the spaces between windows add up in construction cost. For that matter the cost of brick work around a conventional window costs nearly twice as much as that on a straight run wall. That is why architects like to "group the solids together and the voids together" when they design their fenestration patterns. Ceilings heights established in the drafting room without thought to dimensions of standard wallboard units also lead to construction waste. Just how expensive are such wastes? Because of past experiences, when estimators figure school jobs they generally include about 20 per cent waste for lumber, from 2 to 4 per cent for brick, from 5 to 10 per cent for wallboard (depending on the finish), about 5 per cent for asphalt tile, and 10 per cent for concrete materials. When an automobile or a refrigerator comes off the assembly line, there are no broken off or sawed in half pieces left over; the parts have been engineered beforehand. During these last few years most of the manufacturers of building material have been trying to get together to coordinate the sizes of their respective products so that a wall of brick backed with tile with a window in it will fit together without waste. William Demarest of the American Institute of Architects tells of this Modular Coordination program and its effect on school economy.[32] He quotes one mason foreman as saying that on a particular job where the architects had specified modular products and produced modular plans the work was completely finished in two-thirds of the time usually spent on such jobs.

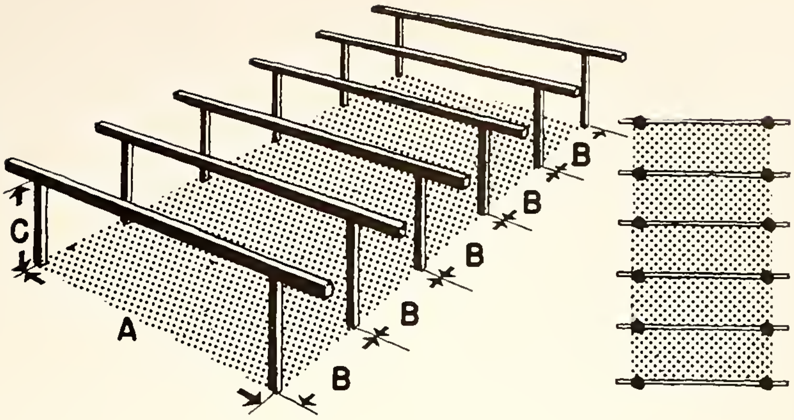
As a summary of this very brief discussion concerning the structure and construction methods a graphic outline has been prepared, under the headings of (A) repetitive structural units, (B) fewer and larger products, (C) speedy erection techniques, and (D) modular coordination. This outline is based on an article by the author which appeared in *School Executive* in January, 1949. In the final analysis the architect is the school planner who should determine exactly what kind of structure and what related construction methods should be used. School boards should give the architect as much freedom as possible in such selections.

GETTING THE GREATEST VALUE OUT OF THE FLOOR SPACE

Although the floor space will be discussed in much more detail in Chapter 6, the subject does come under the heading of economy, and it will be discussed here briefly. If real economy is to be achieved in planning schools, we must cut the fat out of building plans. Areas which are seldom used should be eliminated. Home builders have stopped building large dining rooms which are only used a dozen or so times during the year. Church builders have stopped sizing the sanctuary to fit the Easter Sunday crowd. School builders too are beginning to think in such terms of economy. They are doubling up on the uses of spaces used only part of the school day, such as the play areas and assembly areas of elementary schools. We have already added to our planning vocabulary such phrases as "the all purpose room," "the multi-purpose hall," and "the cafetorium." If combining spaces within the school plant does not interfere too much with the educational program, then it makes sense. But here lies the question —just how far can we go without hurting education? Combinations of high school gymnasiums and audi-

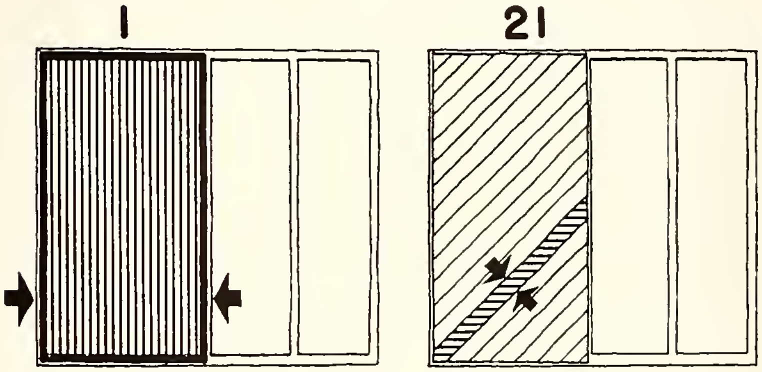
Economics in Structure and Construction Methods

Illustration 108



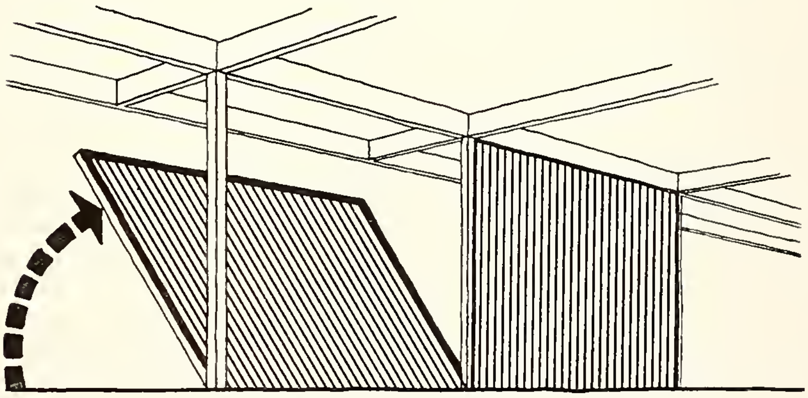
A—Repetitive Structural Units

By the use of repetitive structural units, labor time may be cut considerably because of mass production methods, regardless of whether such units are wood, steel, or concrete.



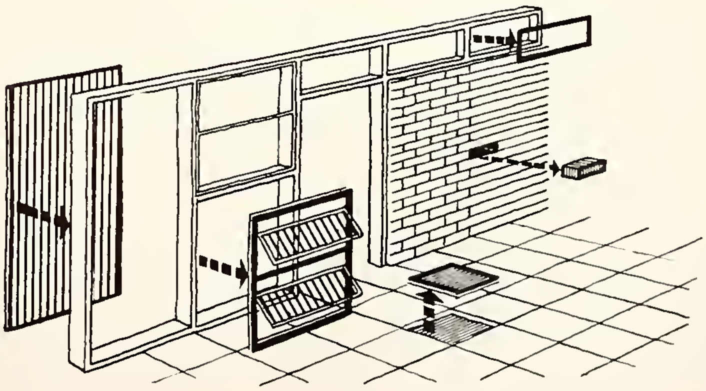
B—Fewer and Larger Products

Economy may be achieved through reducing the infinite number of small pieces of building materials by the use of large units such as wallboards, cement-asbestos panels, gypsum board sheathing, and plywood.



C—Speedy Erection Techniques

Because of the increasing proportional cost of labor over materials, economies in construction may come about through the use of speed erection techniques such as the lift-slab method, drilled type footings, tilt-up slab methods, and power tools.



D—Modular Coordination

Economy may be achieved also by the use of modular coordination, which takes advantage of standard shapes and sizes of building materials and eliminates waste caused by cutting and fitting of these materials on the construction job; in essence modular coordination is the use of building materials which have been sized and shaped to be integral parts of a modular wall, roof, or floor.

toriums, for instance, have never proved successful. Principals who have to schedule their use have a hard enough time, but the pupils and teachers who must use these half-breeds find them much more difficult to use. Fundamentally, these two spaces, the largest in the school, are as different as day and night. The envelope for the gymnasium is intended merely to modify the forces of nature to permit play under shelter during inclement weather. In some climates about the only thing that it needs is a roof high enough to allow such games as basketball and large enough to keep the sun and rain off the playing court. The space involved has a very close relation to the outdoors. The envelope for the auditorium has quite a different function. Its purpose, among other things, is to isolate the audience from outdoor disturbing factors such as extraneous sounds and natural light. Most school planners agree now that to combine the gym and the auditorium is simply poor economy. There are many other combinations that work much more successfully. These will be discussed in Chapter 6.

A very obvious waste of floor area is the corridor. As some planner put it, "We can't teach in the halls." An analysis of the floor plans of twenty schools[13] shows that the floor area devoted to corridors and stairs totaled as much as 27 per cent in some schools. That seems to be an excessive amount of space to be used only for walking. It seems a particularly bad situation for elementary schools, where the pupil stays in his individual classroom most of the time. Taxpayers who want every square foot of floor space to be used for educational purposes frown on such arrangements, and with good reason, too. Can we do anything about it? Yes, by careful planning, corridors and stairs can be cut to a minimum. If corridors must be used as circulation areas, at least we can put them to work for education. The multi-purpose hall as described in Chapter 2 in connection with the Norman High School is one way of putting the corridors to work. Refer to Case Studies 8, 22, 34, 57, 58 and 79, also.

The outdoor corridor came about through economic considerations. During the planning of two elementary schools in Blackwell, Oklahoma, for example, it was estimated by the architects that four extra classrooms could be added without any extra cost to the original 14 classrooms planned, if outdoor corridors were used instead of more expensive heated corridors. Although it had never been done before in this north Oklahoma area, the school board decided to go ahead with the outdoor corridor scheme and utilize the floor space generally used for walking as classroom area. The school has been in operation now nearly four years and it has proved a very economical school. For a similar situation in Michigan, refer to Case Study 25. Apparently the trend towards outdoor corridors has come about from economic necessity.

FIRST COST vs. MAINTENANCE COST

A hidden cost that cannot be ignored by planners interested in true economy is that of custodial service and maintenance, and it is not an easy cost to figure. It is obvious, for example, that a 4 x 10 paper-board wall panel for an elementary school hallway is no economy over a quarter-inch plywood panel of the same size. While it is in use, the paper panel will require more and tenderer care, and it is almost certain to require replacement much sooner than would the plywood panel. But what about a choice between a rough interior brick surface and a cement-asbestos tiled wall? Suppose both have the same acoustical and other functional properties, and neither requires surfacing? The cement-asbestos wall is considerably cheaper to begin with, but not quite so strong as the brick one. Which has the lower total cost over the entire life of the building? Which is really cheaper, asphalt floor tile or battleship linoleum? There is no need to multiply examples further; it is clear that custodial service and maintenance have much to do with real costs.

Planners quite readily see the added costs of refinishing and replacing materials, but often they do not pay enough attention to the cost of custodial service. The school janitor does not work for nothing, though he and his family sometimes feel as if he does, and he is a busy man. Dr. Henry H. Linn's book on maintaining schoolhouses[34] includes a series of custodial forms which are checklists for rating custodial service. The list for classrooms and libraries alone includes forty-nine items which are the custodian's responsibility. The combined total of checklist items the janitor has to maintain in a single school plant is 555! And these are items that have to be checked or done often, many of them daily! It is apparent that the quicker and easier each item is to do, the smaller will be the custodial staff required. Clearly the various planners should get together and consider carefully the rate of custodial and maintenance service in school economy. Incidentally, this whole subject suggests that schools generally could use more janitors than they have and that the wages of the additional men might be less over a period of time than the maintenance costs caused by an inadequate staff.

Architect Frederick V. Kershner thinks that the solution to the maintenance problem lies in the design of the buildings. He expresses himself in these well-chosen words.

> First of all, regardless of who we are or in what region we work, one basic fact exists: Although there are exceptions where schools have competent custodians and consequently have excellent maintenance, the majority of buildings of a public nature are sorely neglected. Why? Usually, those charged with custodianship are either looking forward to an old age pension or are of a moronic mind, with only eye

		ULTIMATE SCORE		senior high		junior high		elementary school #1		high school gymnasium		vocational agriculture #1		lunch room		vocational agriculture #2		Blackshear school		elementary school #2		new school Blackwell	
SITE	LOCATION	5	10	4	8½	4	7½	1	2	4	8½	4	7½	4	7½	4	7½	4	7½	3	6	4	8½
	SIZE	3		3		2		½		3		2		2		3		3		2½		3	
	LANDSCAPING	2		1½		1½		½		1½		1½		1½		½		½		½		1½	
EDUCATIONAL ADEQUACY	CLASSROOM SIZE	5	25	4	18½	5	14	2	10	4½	16	5	19	3½	14	4	12	4	14	4	14½	5	24
	ATMOSPHERE	15		11		6		6		8		10		7		6½		7½		8		15	
	EQUIPMENT	5		3½		3		2		3½		4		3½		1½		2½		2½		4	
STRUCTURAL ADEQUACY	FOUNDATION	5	20	4	15	3	11	3	11	5	18	4	16	3	11	3	11	4	12½	4	13½	5	20
	WALLS	5		4½		3		3½		5		4		3		3		3		3½		5	
	ROOF & ROOFING	5		3		3		3½		4		4		3		3		3½		4		5	
	FLOORS & CEILING	5		3½		2		1		4		4		2		2		2		2		5	
LIGHTING	NATURAL	10	15	4	6	4	6	4	5	5	8	5	8	5	8	4½	8½	4	8	4	8	10	15
	ARTIFICIAL	5		2		2		1		3		3		3		4		4		4		5	
VENTILATION	NATURAL	5	15	3	10	2	8	2½	8½	4	8	4	8	3	8	3½	9½	3	9	3	9	5	15
	MECHANICAL	10		7		6		6		4		4		5		6		6		6		10	
MAINTENANCE & SANITATION	MAINTENANCE	4	15	3	10	1½	4	1½	5½	3	10½	3	9	2	8	1½	5	1½	7½	2	5½	4	15
	SANITATION	6		4		½		2		4		3		4		1½		4		½		6	
	WINDOWS & DOORS	5		3		2		2		3½		3		2		2		2		3		5	
TOTAL SCORE		100		68		50½		42		69		67½		56½		53½		58½		56½		97½	

109. Here is an Evaluation Sheet filled in for scoring the worthiness of the school plant of a small community. It was developed by Architects Tom Bullock, William Pena, and the writer. How is it used, and for what purpose? The age of a schoolhouse is not an infallible index of its usefulness. Even the "old timers" still offer much service to education and the children involved. Before any plan for a program of construction is made, relating either to old or new structures, a thorough examination must be made of the existing school plant. The prescription is always preceded by a thorough examination. The Evaluation Sheet shown here serves as a check list and score card for the examination of the existing plant. This particular score card, (there are many others, good ones, being developed, and the granddaddy of all is the Strayer-Engelhardt Score Card published by Columbia University) has six major criteria as listed on the left. 100 points equals a hypothetically perfect school plant. The use of various score cards is a common way of evaluating existing buildings. This technique is probably as good as any, if the scoring is done for all schools by the same group or the same individual. If not, the score has very little value, since such value is qualitative, not quantitative. It is best that an architect serve as a member of the survey team. If the score indicates renovation, certainly the architect who must prepare the plans should have a say as to what changes should be made. An intelligent use of score cards will indicate in the long-range program which buildings should be abandoned and what remodeling should be done to fit the other buildings into the ultimate scheme.

level vision, hookworm attitude, and a live-today philosophy. These custodians, underpaid in comparison to standards, over-paid in comparison to production, take over a nice, new, clean building and slop and mess and literally beat it to pieces. Automatic controls to them are new-fangled gadgets to be tampered with. Gasoline and lye are still the best cleaning materials, and the architect is a nut. There is no doubt that this attitude can be corrected, but not until boards of education hire building managers for principals or building engineers at a principal's salary. This, we know, won't be done soon. We must then design something that these demolition experts cannot wreck without exerting excess efforts. While what is said is perfectly true, there are exceptions where schools have competent custodians.

Whether economies in maintenance lies in the design of the buildings, as Architect Kershner so ably puts it, or in the training of the custodian, will probably never be completely decided. In order to whip the problem we probably should do both—take Kershner's advice and design buildings for easy maintenance, then do everything that we can to bring the judgment and skills of the custodian up to the quality of the schoolhouse.

A second major hidden cost is insurance. Everybody knows that insurance rates vary with different types of construction, but few are fully aware of how much they vary. And even fewer stop to figure what that difference means when translated into total money paid over the life of the building.

There is no room here for anything like a full discus-

sion, but the following table prepared by the Pacific Rating Bureau may be considered indicative, even though it does represent only one small section of the country:

FIRE INSURANCE RATES OF TYPICAL WEST COAST CITIES

Class A & B	Fire-resistive Construction	30¢ per $100
Class C	Masonry Construction	45¢ per $100
Class C	Masonry Walls, Wood Floors, and Roofs	54¢ per $100
Class D	Wood Frame	80¢ per $100

This table shows the insurance rate for a wood frame building to be 2-2/3 times as high as that for a fire-resistive structure. Should planners, then, on this ground, decide against wood-frame as an economical type of construction? The problem is not nearly so simple. The initial cost of a wood-frame structure is invariably much lower than that of a fire-resistive structure, and wood-frame has other advantages to be considered as well. Planners must consider the loss ratio figures as well, as in the instance being cited those figures are as follows:

Type of Construction	*Loss Ratio*
Frame	34.7%
Brick	43.6%
Fire-resistive	50.0%

(Ratio of loss to Insurance Premiums for Educational Buildings in Protected Areas, State of California—Year 1948).

What conclusion is to be drawn from this set of figures? This book does not pretend to offer authoritative conclusions about insurance. But it might be significant to note that wood-frame construction is very popular in California, where these figures originated. The suggestion is that planners would be wise to invite an insurance man to help them arrive at the most economical solution.

Before closing this discussion on maintenance and first cost, the author wishes to apologize for his statement made in *Space for Teaching*[13] written eleven years ago. But it sounded like a good idea at the time. The statement went like this:

> We know that a monumental building veneered with classical gewgaws may be the pride of the community. We also know that usually it is a "white elephant" to school officials who must use this type of building for education. Even worse, the community cannot afford this type of building with all the expensive trimmings.
>
> In order to pay for an expensive structure, a long range installment plan is necessary. Usually this period of amortization is 40 years. (State laws require that the period not exceed 40 years). These grandiose buildings are obsolete before the halfway mark is reached. While teachers are clamoring for more space, the community is still digging deep to pay for the inadequate space of the up-to-date school, built only a few years ago. And if the community had known that it was paying not for space, but for the "decorations" so essential to "beautify" the school, it probably would not have passed those school bonds in the first place. Paying for expensive buildings takes time. Education cannot wait. It is a living institution . . . it grows. Architecture must provide for this growth. In order to educate our children properly, we must cut down the amortization period. Why not build a school that we can pay for in 15 to 20 years, and then if it does not serve the function of education at the end of that period, tear it down and build another more suitable to education at that time? We can build it of materials that will have good salvage value.
>
> Of course such a building cannot be adorned with the "ginger-bread" considered essential to most of our schools, but at least we can house our children in buildings that conform to progressive educational programs. The boy who outgrew his short pants was not given a tuxedo; he was given inexpensive, good, practical pants that he could use. Education likewise should be given inexpensive, good, practical buildings that can be used.

When the author wrote that he was in his professional "short pants." Most of it will hold true today, however. Most school planners now agree forty years is too long to pay for a schoolbuilding. And it still holds true today that we can leave off the "ginger-bread" and have beautiful as well as economical buildings. But what the author disputes with his much younger and less experienced self about is the proposal to build schools which can be paid for in 15 to 20 years, then to tear them down and try again. It is simply not very practical to do that, except perhaps in an emergency situation. What probably is a better scheme is to build more permanent schools designed for ultimate flexibility. Perhaps the roofs and floors and a few of the exterior walls could be made of permanent low maintenance materials and the interior spaces subdivided with the "materials that will have good salvage value." Then we could have both low maintenance and flexibility. We may not have exact answers yet to this problem, but before long the requirements of low maintenance and flexibility will not be incompatible.

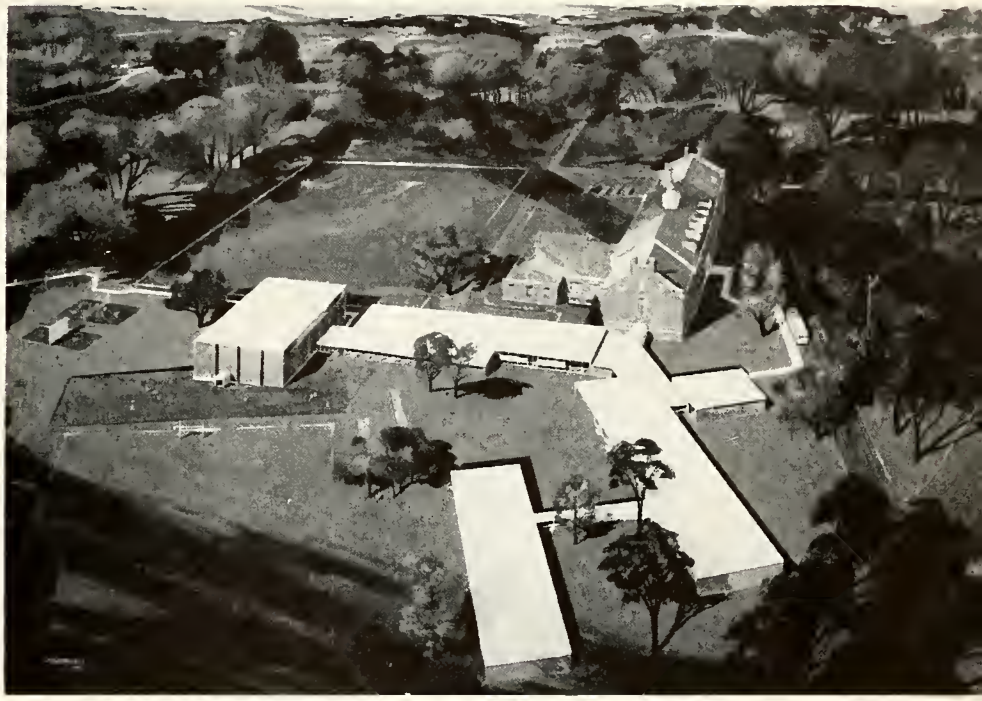
ECONOMY AND OLD SCHOOL BUILDINGS

Planners interested in economy are certain to want to use the existing buildings as long as possible and to repair and remodel them until the point is reached where it is no longer economically practical to do so.

Some old-timers were built so sturdily that they represent excellent risks so far as maintenance is concerned, and if this were the only consideration, a good

Additions: Old Style or New?

110-111. Shall we make additions to existing buildings look like the old structures? The answer to this time-worn question is: "Emphatically, No." Education changes from year to year; its architecture should change with it. Every year there are new developments in architectural planning and building materials. Even additions should take advantage of such improvements. We should not build carbon copies of architectural obsolescense just to have "harmony" with existing structures. If architecture is incongruous with its Time, there is nothing of "harmony" about it.

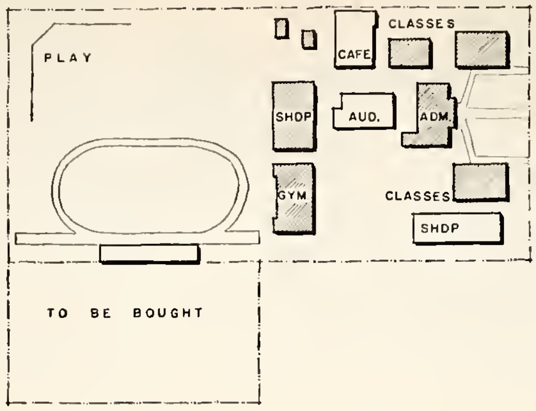


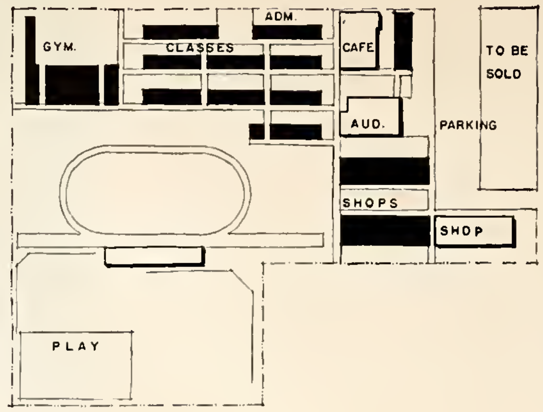
many communities could feel fortunate in having them. But because there are other considerations, even the best preserved old relic can be a real liability.

Schools which were erected to serve the functions of education as they were conceived at the turn of the century might actually interfere with today's educating methods. Educational theory has changed considerably during this century, and requirements for educational facilities have changed with it. Planners should take a good look at their oldest buildings to see to what extent they can be adapted to suit today's educational needs. They should also examine the buildings for safety, adequate heat and ventilation, proper lighting, and health. If the schools are not adaptable to the educational program or desirable from the standpoint of environment, it might be advisable to raze them even though they are in good condition.

Sometimes desired alterations in old school buildings involve structural changes. School boards would do well in such cases to consult an architect before reaching a decision. There have been cases in which even the most unpromising-looking buildings were so designed structurally that the trained eye has been able to give them a new usefulness. And there have been others in which nothing could be done structurally to make the old schools do the job they were supposed to do.

The decision to remodel or to raze should be made not according to preference but after cold, objective analysis which overlooks none of the factors involved. One such project is the current renovation program in New Orleans under the leadership of Charles R. Colbert, Supervising Architect and Director, Office of Planning and Construction, Orleans Parish School Board. The following excerpts taken from his July, 1952, report to





112. These sketches show how an existing school plant was adapted to a long range building program. The layout on the left shows the existing plant, and the one on the right shows the proposed school plant. Some buildings are scheduled to be abandoned; others (auditorium, cafeteria, and shop) are planned to be parts of the ultimate school plant. It is a difficult task to decide whether a building should be abandoned or renovated. The final decision should be withheld until a careful survey is made of the existing school plant.

the School Board may help us as school planners see the value of old buildings as an educational asset and to be in a better position to know what to do with our own.

In 1951, the citizens of New Orleans were shocked by a realization of the extent of the backlog of school building neglect in their city. Two wars, a depression, and a unique social structure had allowed an accumulation of school repairs to reach staggering proportions. When a definitive evaluation of the situation was finally made, the citizenry was alarmed to find the institution of public education in a state of near collapse. Through their School Board, New Orleanians found that all of their 89 public schools had been declared either unsafe or unsanitary by City and State regulatory agencies. Educators and architects found that only 42 schools could be retained as reasonable educational facilities beyond 1970. Thirty others were deemed useful for a life of not more than 10 to 20 years, while 17 required either immediate replacement or major repairs and space revisions.

These facts, coupled with the disconcerting knowledge that the population of the city had increased 15 per cent since 1940, that no new schools had been built in the last 10 years, that birth trends were continuing the wartime upswing, and that thousands of young families had moved to newly developed outlying areas, presented an almost insoluble problem.

Taking stock of its resources, the School Board found that its entire allowable bonding capacity would permit only 25 per cent to 30 per cent of the facilities required if conventional corrective action were undertaken. Total dependence upon replacement by new construction was obviously impossible. Extremely high real estate, material, and labor costs, and the Federal controls on building materials indicated the necessity of expedient measures which still would not compromise educational values. The continued use of many old structures through simple but thoroughly planned renovation was the only possible avenue of action.

While exploring the none-too-enticing prospect of renovation and the continued use of condemned and apparently obsolete structures, the Board was amazed at some of its findings. For example, one high school erected in 1913 for $360,000 had an insurance evaluation in 1951 of $960,000 or 167 per cent more than the initial cost of the structure. Yet the building had not received an entire coat of paint or other basic measure of maintenance since the construction. For continued educational usefulness, it was mandatory to rearrange many spaces, add facilities, repair, and refurbish. The cost of renovations was fixed at $468,000 or 30 per cent more than the cost of the original investment. The collective eyebrows of the Board were considerably lowered, however, when it was pointed out that the provision of identical facilities today would entail the expenditure of over one and one-half million dollars (four times the cost of the old structure.) In addition, a new site would have to be acquired or the students removed while the old building was razed and its replacement constructed on the same site.

Educational developments in recent years have created obsolescence in many school buildings, but in our studies we found it to be a dangerous fallacy to judge a structure's educational usefulness by its age. Some school buildings of nineteenth century vintage are in reality far more useful education plants than their later day counterparts. In this respect, it is interesting to note that single-loaded corridor schools were erected in New Orleans in the 1920's, while the four-story Gargantuans did not evolve until the 1930's. Corridorless schools were

built in the 1880's, and exterior bearing-wall and free-standing partition constructions were common just after the turn of the century. Many of these old structures having non-bearing interior partitions, spacious floor areas, and adequate fenestration lend themselves to simple and economical remodeling as satisfactory, and at times excellent, educational facilities. Although student capacities will usually be reduced because of present-day educational concepts which demand larger and more complete physical facilities, the cost of renovation will remain far below that of new construction.

The Orleans Parish School Board has come to the conclusion that our older school buildings must be considered analogous to other important residual assets of the community. They may be exploited, destroyed, or used with care. These debt-free facilities in many instances contain materials, craftsmanship, and solidity not to be duplicated today. The existence of a reasonably sound structure purchased before the day of the devalued dollar is an enormous financial asset. Education may not soundly proceed without regard for such a valuable resource. Of course, replacement must be continually balanced against renovation costs and the respective educational values of each.

When renovation is decided upon for budgetary or fiscal reasons, it must be undertaken in a judicious manner. Planning the renovation of schools must not be precipitous nor approached from the basis of the individual unit. A system-wide building plan is imperative, since every structure must be related to and compared with all other facilities in the system. Each school building has a determinate useful life, a definite economic status, and a particular degree of intrinsic value. Those factors may not be weighted properly by individual school units.

Though we are extremely pleased with the results of renovation, it must be clearly understood that we in no way wish to imply that renovation is a cure-all, nor that it should be fairly compared to the far superior educational potentialities of new construction. However, old structures properly planned and renovated may have their useful lives extended and educational conditions vastly improved. A rich resource may be further utilized in this manner and improved learning conditions brought within the reach of many more of our future citizens.

Architect Colbert's remarks vividly point out that although we may wish to "tear down the old ones and start all over" our economy will not always let us. The existing school plant represents a great investment to the taxpayer; we must use it to fullest advantage. It takes, too, an imaginative architect to get the most out of the old buildings: one like Ernest J. Kump, who developed the long-range scheme shown in the accompanying sketches.

The question, "What should we do with our old building?" is no different from the one, "What should we do with our old car?" The answer is probably the same, too. It depends on how badly off (or well off) we are as a community. If we have the money, and are willing to pay for facilities over and above what we have, the old school building may not look so important to us. Dr. J. Chester Swanson pointed this out in a speech to a group of school administrators recently when he said:

> Educational services are subject to the same fundamental economy laws that prevail in purchasing any article.
>
> 1. You get what you pay for.
> 2. You are willing to pay for something if you want it bad enough.
> 3. Educational service is government service and in competition with other government services.
>
> When these basic economic laws prevail, it becomes vitally important that educators accept the responsibility of explaining to the public what educational services are available for their tax dollars and what other services additional tax dollars might buy if they wish to pay for such services.

His reference is to education in general, but the same thing applies to educational facilities. Whether the old building comes down or not depends so much on the attitude of the community and whether or not that community has been completely informed of all facts pertaining to the building.

Before a decision is made one way or the other, the school planners should have answers to the following questions concerning the old building:

1. Does the building fit the educational program, and if not, is it economically feasible to adapt it to the program?
2. Does the building require heavy maintenance, and if so, would repairs cut maintenance enough to justify the expense?
3. Is the building safe, and if it is not, can it be made safe without unreasonable expenditures?
4. Is the building a pleasant place to go to school, and if not, is it possible to make it that way?
5. Does the building have adequate lighting, ventilation, heating, and sound conditioning, and if not, is it practical to have improvements which might make the environment as it should be?
6. Are the sanitary facilities satisfactory, and if not, can they be made so?
7. Is the building properly located and does the location offset the advantages or disadvantages of the structure?

By the time these answers are obtained, the answer to the question, "What should we do with our old building?" will have already been found.

BID LETTINGS AND THEIR EFFECTS ON COSTS

In the early part of this chapter we discussed how the geometry of the envelope and its fabric and structure greatly influence school building cost. So does the bid letting, and a great deal. Experienced architects are often heard to ask in conversations on current construction programs, "Did you have a good letting?" What they mean is: Was the letting timed when the contractors really wanted the job? Was there keen competition among the bidders? Did a large number of contractors bid on the job? Was the letting free of such disturbing factors as threatening labor strikes and material shortages?

Local school boards, architects, and school administrators have very little control over such things as labor strikes and material shortages, except, perhaps, in a small way on the local level. But they do have some control, for example, over timing.

Sometimes only a few days can mean the difference between good and bad lettings. In one such case, a town had two different schools ready for bids and both had unique construction systems which greatly interested a small group of contractors. These contractors were reluctant to bid on both jobs because either would have required all of the low bidder's crew and equipment, and for that reason decided to bid only on one job. The architects of one of the schools heard about this and recommended to the school board and school administrators that the letting for one school be delayed a few days to allow the unsuccessful bidders of the first letting try on the second. The result of a four-day delay was a five per cent lower bid than would otherwise have been received and a saving of thousands of dollars.

In another case, in which a legal entanglement forced the letting for a large high school to be delayed nearly a year, one of the bidders said that his bid was ten per cent lower than it would have been a year earlier.

There have been many cases in which such delays saved money, but they do not justify any general tendency to delay. The general trend, as will be pointed out later, is toward progressively higher costs, and many school boards have been justly criticized for causing the taxpayers substantial losses through procrastination.

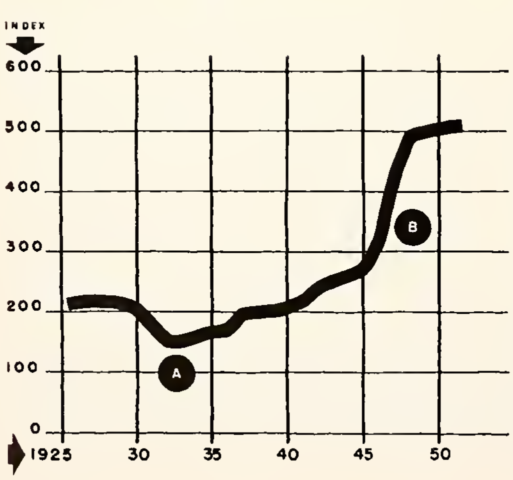
The solution generally is to build as soon as possible and to delay only when a study of local conditions and of fluctuating construction costs and construction activities offers specific reasons for believing that delay for a certain period of time will produce lower bids.

Dr. Harold F. Clark, who knows his school building costs as well as anyone, has this to say about when is the best time to let building contracts for school buildings: "The problem varies so much from section to section that it is difficult to find material dealing with all aspects of the problem. The tendency, of course, is to let contracts at the time of the year when other contracts are being let. Naturally, this should be avoided, if it is convenient to do so. In sections of the country where the building trades are highly seasonal, this can be particularly important. I think the best general comment I can make would be to let the contracts when other people are not letting theirs, but even this statement has to be modified, depending on the individual situation." This bears out one of the cases mentioned before. Finally, it should be remembered that even the most economically designed school can turn out to be expensive if letting is held at the wrong time. We should take great care in scheduling lettings.

FALLACIES OF COMPARING CONSTRUCTION COSTS

The next discussion is largely negative; it will concern mostly what not to do instead of what to do. Estimating the cost of one school and allowing for the many variables is difficult enough; comparing costs among schools is vastly more difficult. Yet planners often hear, "Five years ago, such-and-such county built a school almost exactly like this, and it cost lots less than this one! How come?" The implied charge ought to be answered, of course, if the planners are to keep peace in the community, but the answer is never easy.

Building costs fluctuate. A Dallas school built in



Fluctuating Construction Cost

113. This chart shows the yearly variation of construction cost indexes. It tells what the construction dollar at Dallas could buy during the period from 1925 to 1952, and is based on the 1913 figures. The index number for that year is 100. A study of the chart shows that in 1913 school boards were getting five times the dollar's worth for what the dollar was bringing them in 1950. The purpose of this chart is to show that construction costs cannot be compared without considering the yearly variation. The chart tells another story. Note the dip at "A" and the abrupt rise at "B." The dip is caused by the depression, and the rise is caused by rebuilding after the war. Unfortunately, fate deals economy of school construction a cruel blow. When we can get the most for the dollar, (see A) we apparently are not in the position to build schoolhouses. And the minute we start building them (see B), the construction prices begin to rise. (Construction and Building Cost Indexes—1914-50. From: Statistical Abstract of the United States 1951—U. S. Dept. of Commerce—72nd Edition Supt. of Documents, U. S. Govt. Printing office, Washington 25, D. C., pp. 718)

1914 at a cost of $100,000 would have cost $204,000 had it been built in 1927. The same school would have cost $139,000 in 1933, and today it would cost almost more than it would be decent to mention. Construction costs in Houston are rarely the same as those in El Paso. And costs between different states and different sections of the country, quite naturally, vary even more, although it must be admitted Texas covers a large area. Fortunately, yearly variations have been recorded for many localities so that there is some basis on which to compare costs.

Construction cost indexes derived from these records are the only bases on which such comparison can be made. But the cost indexes by themselves are seldom adequate. They do help adjust cost differences between schools built in different times and places, but cost difference may be caused by things other than that. First, there seem to be many ways of estimating cubage and square footage of buildings, although there are recommended standards for these calculations. Second, waste in planning often counteracts the value of unit costs. Third, built-in equipment raises the unit cost somewhat. Fourth, of course, the type of construction has a great deal to do with the unit cost.

The fact that fair cost comparisons are difficult does not mean that they are valueless. If planners use them carefully, they can determine whether a proposed school really is economical. By studying closely the costs of a particularly successful schoolhouse, they can learn just where that school effected its greatest savings. In this way planners can learn from one another and thereby produce even better and cheaper schools.

It is apparent that with comparisons so difficult and at the same time so valuable, something ought to be done to make them both easier and more accurate. The planners need a standard comparative method based on usable space measured uniformly. The standard should allow for various types of construction, for built-ins, and for "extras." Above all, it should compensate for schools of different kinds and sizes.

Architects throughout the nation have been working towards such a yard-stick for comparing school cost, but at this writing no standard method exists. The nearest thing to it is the one developed in California under the leadership of Architect Henry L. Wright. The method first sets up a standard way of calculating the unit of measure, in this case the unit cost per square foot of area. Next this method calls for three different classifications of building construction—such as frame, masonry, and fire-resistive. After the number of square feet has been calculated, the building is given one of the three classifications, then it is given still more detailed classifications under such headings as "adequate sun controls," "proper amount of storage and built-ins," and "sidewalks and drives," and many more. A method like this, which pin-points the classification of each school, might be what we are looking for.

THE OVER-ALL PICTURE OF ECONOMY

Unfortunately there is no individual construction technique, no single planning method, no one building material which will bring about a low-cost schoolhouse. Instead, the low-cost school is the result of an accumulation of savings made at every stage from the earliest sketches through the selection of materials and the choice of construction techniques, to the completion of the building, and even beyond that, to the maintenance and custodial service.

The ideal situation, of course, is for all the planners—educators and school board members, as well as architects—to have at least a general idea where savings can be made. This has a double advantage: (1) it helps the architects by freeing them from expensive restrictions sometimes imposed upon them by the clients (strange as it seems, architects often have to fight to save money); and (2) it helps the other planners to protect their own purses in cases when their architect has expensive ideas; there are architects, but not many, who happen to like colonial slip covers, for example, or ornamental belfries, or other such money wasters, and who have not yet embraced new and better and cheaper materials and techniques.

While it is often difficult actually to effect maximum savings, it is not hard to see the general areas in which the savings potentials lie. It should be remembered that the monumental school burdened with gew-gaws isn't the only expensive school; the simple structure with a low first cost can be an offender, too. Real economy comes from a careful balancing of costs of all kinds over a long period of time. In this, as in all other phases of school planning, it is the long-range view which pays off.

WELFARE OF THE CHILDREN COMES FIRST

In the final analysis the pupil is the yardstick to determine economical measurements of schoolhouses. Architect John L. Reid, who, like so many other good architects, feels the responsibility of the welfare of the children when he says:

> "The architect who undertakes to design a school assumes a many-sided responsibility. To the burdened taxpayer, he must deliver a school plant that provides the most for the least, and he must prove in creative terms that art thrives on economy. He must come to the educator with experience, an insight into teaching problems, an understanding of the aims and philosophy of the educator's profession; he must then bring into being a school plant that will be a responsive instrument of education in the hands of the teacher. He must discharge his debt to his profession by designing not only a sound building, but a worthy architecture and an asset to its community. And his major responsibility is to the growing, learning child whose

life, and ultimately whose world, will be better or worse for the architect's effort."*

Economy in school building programs is both a necessary and a desirable thing, but it can be an evil thing if the planners allow themselves to forget that the objective of the entire program, including the money-saving activities, is to provide schools that will help the children to learn. Schools can be constructed too cheaply! And they are every time an economy is brought about at even the smallest expense of learning or health. The planners' purpose is not to save money, but to save money for something. And that something is the best possible educational environment for their children.

* by letter

CASE STUDIES WHICH ARE RELATED TO CHAPTER 4

No.	*Problem:*
6	Does the geometry of classrooms affect construction costs?
8	Can corridors be used for educational purposes?
12	Are pipe runs feasible in spaces other than underground pipe trenches in one-story, basementless, flat-roofed buildings?
14	Can economy be achieved by plan arrangement?
22	Can combination of spaces be used effectively in small community schools?
25	Can open type corridors be used successfully in the northern-most areas?
31	How can construction be speeded up?
32	Can low budget gyms be lighted by natural means effectively?
34	How can provisions be made for an interim lunch and activity area for the first unit of an eventually complete elementary school?
35	Can flush ceiling surfaces be achieved without expensive, cumbersome dropped ceilings?
36	Can both auditorium and playroom be provided at reasonable cost?
37	Can bilateral lighting on a double-loaded corridor arrangement be provided at low cost?
41	Can economy be achieved through changing the geometry of the layout of classrooms?
47	Can a compact plan arrangement be made without sacrificing natural lighting and natural ventilation?
59	How effectively can a large auditorium, a little theater, and an arts and crafts unit be combined?
60	Can the gymnasium, the auditorium, and the cafeteria in elementary schools be combined successfully?
62	Is a quadruplex classroom arrangement feasible?
71	How can you eliminate the floor space generally used by a platform in a multi-purpose room?
73	Can an auditorium lobby have a multi-function?
74	Can very large assembly spaces be multi-functional?
75	Is a campus school layout desirable for northern climates?
77	What form of concrete building frame is most simple and economical?
79	Can corridors be eliminated?
87	Are the requirements of flexibility and economy compatible?
88	Can schools and parks be combined successfully to satisfy economical and operational requirements?
90	What are the requirements of the building fabric?

CHAPTER 5 CITY PLANNING AND THE SCHOOL PLANT

Imagine the very famous and beautiful Crow Island Elementary School sitting in the middle of the manufacturing district of Chicago instead of in the quiet, restful residential area of Winnetka! This school is an architectural classic, and like all classic examples of architecture it depends on its setting for a great part of its architectural effect. The school and its setting form one integrated unit not unlike that of a portrait with its necessary background.

A schoolhouse not only depends on its setting, but it is itself a part of the setting, and the setting is a part of the school. We can draw no line between the envelope and its surroundings so long as we have glass in our architecture. The thermal forces may stop at the window sill, but the atmosphere outside of the classroom does not; both physically and psychologically, the envelope is transparent. Moreover, the pupil plays and learns both inside and outside the school building as well as both during and outside school hours. This means that we have not only the classroom, but the school site and the adjacent neighborhood as well to offer the pupil as outdoor laboratories. It means also that as school planners we have a real problem to worry about.

We have no dikes around school sites to hold back the environmental flood of noise and confusion, smoke and dirt and the drabness these bring. But just as the real solution of flood control is not in the dikes, but in the terraces of the fields, so the real solution to environmental flood control lies beyond the boundaries of the school plant. School planners must try to solve the problem at its source (another case of distinguishing between gods of the sea and gods of the river). What does all this mean? It means that the school planner must join hands with the city planner.

WHAT ARE CITY AND REGIONAL PLANNING?

What does the city planner do? His job is to help people live together in a society; through his plans he hopes to make the city convenient, efficient, livable, and beautiful. His concept of planning is no different, in one sense, from that of the architect who designs homes and schools. The problems are the same, but a bit more complex, involving more people and more land. Home planners, for example, must study how people move about in their homes; school planners must study how the pupils move about in a school plant; and city planners study how people move about in a city. But should not these studies of the flow of people, if we are seeking convenience and efficiency in everyday living, be studies first in unity? We could plan the school plant for maximum convenience and efficiency, so far as the school's traffic flow is concerned, but if its pupils, and their parents too, for that matter, are put to great inconvenience between the home and the school, then how can we say the school has maximum convenience and efficiency? The flow of people is continuous—the flow lines of circulation within the house connect with the flow lines of the family car or the community bus which connect to the flow lines of the train or air transport, and so on. The city planner, therefore, must work with home planners, store planners, hospital planners, and factory planners, as well as school planners. His concept must cover everything from a complete understanding of how the community earns its living to how it worships and plays. His city plans represent the coordination of factors constituting physical growth of the community—agriculture, commerce, education, government, business, housing, recreation, religion, transportation, and utilities.

These factors are all interrelated; no single one can be properly developed without its being related to all the rest. Education, of course, is only one of many. The diagram on page 117 shows its relative position in this complex situation, but it shows more than anything else that the school plant must be an integral part of the city or regional plan.

LAND, PEOPLE, AND MONEY—COMMON DENOMINATORS OF CITY PLANNING AND SCHOOL PLANT PLANNING

Ten factors, of which education is one, have been listed as major areas of city planning. These ten have three major considerations in common—people, land, and money. These three are the common denominators of city planning and school plant planning. Since this book concerns the approach to planning school plants, any discussion of city planning will, of course, have to be made at the risk of over-emphasis of the school's part in city planning. Naturally, the city planners who read

this will object to the lack of balance and to the brevity of this discussion, but we shall have to accept that and restrict ourselves to considering these three common denominators in terms of educational facilities. People? We want to know how many children our schools must serve, now and in the future. Land? We want to know where our schools should be located for efficiency, convenience, and effectiveness from the standpoint of the educating process. Money? We want to know how much we can afford, and in what manner we can pay for it.

PEOPLE—THE FIRST CONSIDERATION

Let us discuss people first. Without such a discussion we cannot fully appreciate the many aspects of city planning or understand its importance to school plant planning.

Schools in America, and to varying degrees in other countries, are something more than educational plants in the sense that, say, a small factory is a manufacturing plant that seldom pretends to be anything else. Their functioning, their location, and their cost are the concern not of any small owner or manager group, but of the entire community citizenry. Ours are public schools; they belong to the public and must serve the interests of the communities to which they belong as they have from their beginning in this country. A pioneer nation in the early throes of our democratic experiment brought our schools into active community life by using them for town meetings and other public gatherings for which the local churches, often the only other places large enough, were not considered appropriate by a God-fearing population. From this practical beginning we grew quite naturally into a school-centered people who really take the schools as our own as gathering places for precinct conventions, public forums, and increasing varieties of other public community affairs.

The educators, school board members, and other citizens who are concerned with the future of their schools are nearly always fully aware of this, but they do sometimes misread its importance in their planning. The relative simplicity of the pioneer settlement has given way to the complexity of the modern community in which homes, businesses, government, industry, commerce, recreation, and education have become closely interrelated elements, no one of which can be developed properly without relating it to all the rest. And especially, because of the communal nature of our school system, does this apply to our school plants. What these planners cannot allow themselves to forget is that their school planning must be an integral part of broader community planning.

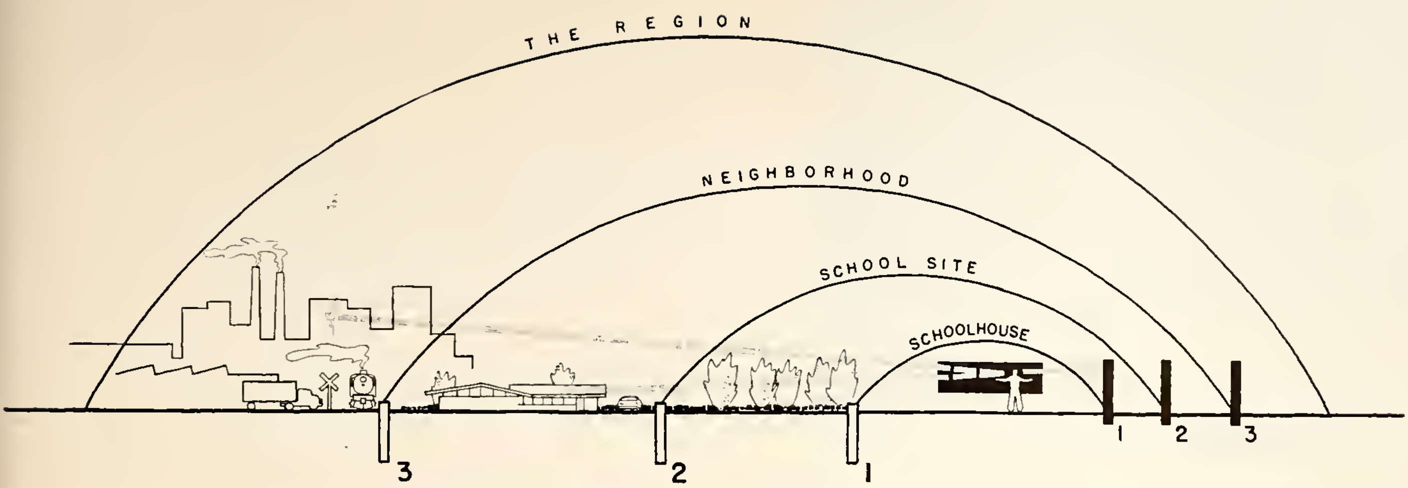
Its exact importance depending on the size and the social and cultural characteristics of the community, the schoolhouse is one of the most important buildings the community has. In some communities it is the most important. (Refer to Case Studies 11, 20, 22, and 45.) The school serves not only the educational needs, but the social, cultural, and recreational needs as well. It serves the children, primarily, but children are not the only people to be considered; the entire population is affected by the school planners' decisions in more ways than are self-evident. American communities have never been reluctant to use their schools for various kinds of adult activities, and they most often use the high schools because the furniture, equipment, and facilities are naturally better scaled and otherwise suited for adult use. Small cities without municipal auditoriums have generally found it cheaper and more natural to use the high school auditoriums than to erect a new building. They hold meetings in classrooms, banquets in school dining rooms, and bazaars in gymnasiums. They use school basketball floors and softball diamonds for church or city league teams.

But the adults are concerned about more than the physical use of the school building. They do not want to worry about running over children crossing busy thoroughfares. They own land and deserve to have its value protected or even increased, as it always is in the area surrounding a new school. Those who operate certain kinds of legitimate business do not deserve or want the adverse criticism they would certainly get if a school were built near those businesses. Those who are parents deserve a chance to live near their children's school in a quiet neighborhood free from hazards. All have a natural interest in the caliber of the future citizenry and deserve schools which can be real educational, social, and recreational centers which will help keep the youth off the streets and out of trouble.

What about the size of the community? In communities of all sizes the adults themselves do make some use of the school plants, for precinct convention meetings if nothing else. But it is generally true that the smaller the community, the more the adults use the schools for their own purposes. In the unplanned community, adults usually have to put up with school facilities which are not flexible enough for adult purposes or construct at much additional expense other meeting places which are adequate. In the planned community these needs are recognized as a part of the community plan, and the provisions for school plants include arrangements for adult use. This is particularly well done in city plans based on the neighborhood unit, which is discussed later in this chapter.

This brings into sharper focus the definition of a city plan. It is not a regimenting device imposed from above to interfere with the citizens' pursuit of their own affairs. It is a device thought out by the people themselves, preferably with the help of trained specialists. It protects property values because it controls the use of land surrounding everyone's property. It preserves the integrity of all the various kinds of neighborhoods, because it is based partly upon a separation of neighborhoods into kinds. It invites industries to move in because it makes clear to them what they can get and where without con-

Eliminating Barriers



114. One of the most significant developments in school planning which has taken place these last few years is the tendency towards eliminating barriers. Years ago the school was conceived in terms of a thick-walled cube subdivided into classrooms, punched with a few holes for windows and doors, and situated in the middle of a bare cinder city block. Only recently the school planners have come to think not so much of the school building as of the school plant. Now, by definition, the school plant takes in not only the building but also the grounds. The definition itself has eliminated the barrier between the enclosed cube and the grounds, but developments of architecture also have helped eliminate the barrier. Instead of having thick masonry walls which separate inside space from outside space, we now have, in many cases, glass walls which pull the two spaces together. The elimination of these barriers extends beyond the school plant, visually as well as physically. There is a definite trend towards placing school plants adjacent to parks. Not only physical and visual barriers are eliminated, but also political barriers. There are some city plans which provide for the school-park to open directly on residential areas. The diagram above illustrates this trend. The barriers between the schoolhouse and the school site (1), the barrier between the school site and the neighborhood (2), and the barrier between the neighborhood and the region (3) have been dropped in current city planning practices as shown in the left of the diagram. What does this mean in school planning? It simply means that schoolhouses cannot be planned independently of the site or the neighborhood or even the region.

flicting with anyone in the community. And it makes for the kind of expansion that will help the city to be a well-integrated, sensibly arranged, attractive community of which truly public-spirited residents can be proud. It is complex enough to make advisable the hiring of a specialist to help draw it up, but its basic elements are easy to understand; it is founded on the desires, interests, and needs of people as related to the land in and surrounding their community.

What has all this to do with the school plant? It is vital to the erection and preservation of an adequate school plant system simply because schools are so essential to any community's well-being. To see how vital it is, it is necessary only to think of the people and the land in specific relation to the community's schools.

The people concerned in this case are primarily children. Citizens who are really trying to develop the best possible schools for their children and are trying to look ahead a little to have a school system that might stay good for a while will shortly come up with all sorts of questions which require answers. One of the most important questions is, "How many children will there be in the community in future years?" During the development of a good city or regional plan, an answer to this question would have already been found. But unfortunately most communities do not have complete master plans, and the information needed to answer this question must be obtained by the school planner. Such a question is vital so far as a proposed school plant is concerned, because its answer determines the size of the plant, but it is also very important to the school administrator who must plan for the future in terms of new teachers and new courses. Considering this, it seems strange that the large majority of school administrators, by the time the building program comes along, have not even started on a prediction study of enrollment. (Studies of future enrollment certainly must be continuous for effective school administration.) Since it is the exceptional school district that has future enrollment figures on hand to start building programs, the next discussion will concern ways to find out how many children must be served in future years.

FACTORS INFLUENCING SCHOOL ENROLLMENT

There are two characteristics of our nation today which affect school enrollment. The first is that we as families roam about during war years, and the second is that our families produce more children during time of war than during normal times, and many fewer during years of depression. So far as the first is concerned, a school district in a defense center could have its enrollment

Good Use of Sites

115. The site can have great educational value or it can actually hinder the educating process. The most beautiful and efficient school plants combine good sites with good building. Here the site and the building are integral. The park-like appearance makes an inviting place for learning.

116. Here is a school that literally grows out of its site. It is hard to tell where one begins and the other stops. This beautiful school plant shows what a creative architect can do with a difficult site situation. It would have been tragic if a prairie type school had been transplanted to this beautiful hillside. The design of the school must conform to the characteristics of the site.

117. Someone once said that a good school plant is a good site partly roofed. There is a lot of learning that can take place even without a roof. Here is one of the most economical laboratories that money can buy, and surprising is the number of days that the pupils can use it, even in northern climates. The real advantage of this outdoor laboratory is the fact that it presents a new learning situation seasonally. There is definitely a trend for educators to make full use of sites for educational purposes. Accordingly, particular attention should be given to this phase of the school program when sites are being selected.

doubled overnight. The second characteristic is reflected in enrollment graphs of nearly every school district. Douglas Haskell, in writing for the *Architectural Forum*, in October, 1949, hits the situation right on the head when he says, "Children, not tanks, planes, or bombs, were the greatest output of the United States during World War II."

Since the growth of the nation is reflected in the growth of the community which in turn is related to the enrollment of the school district, let us review for a minute something that has taken place in the United States since the first World War. In 1920 there was a definite increase in birth rate as well as a house building boom. This wave of war and post-war babies began to hit the elementary school six years later, and by the time the depression of the 1930's was at its worst, the high schools were heavily loaded. About this time, too, more pupils began to feel a greater need for continuing their education through high school. The depression, as all of us know, slowed down the birth rate and consequently produced a drop in elementary enrollment during the late thirties and the early forties. Six years later, 1946 to 1948, the enrollment dip hit the high schools. World War II made the patter of little feet sound like a thunderous roar, and this wave began to cause a great increase in the elementary school enrollments as early as 1946. At the time of this writing elementary schools are filling up dangerously fast throughout the entire nation:

most communities cannot build elementary schools fast enough. What is going to happen when these war babies hit the secondary school level is frightening. The latest census reports show there will be no great let-up in many years. Every local community, to some degree, is influenced by these national population trends. It is very important to study these trends, then, before forecasting local trends.

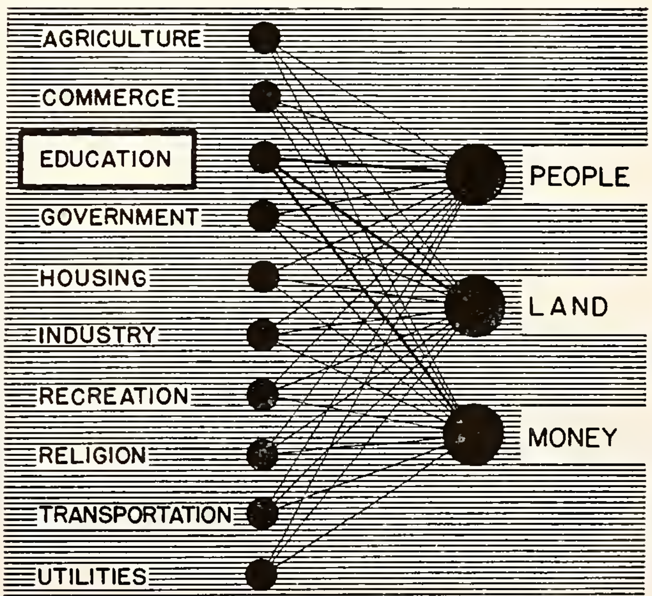
METHODS FOR FORECASTING THE ENROLLMENT

It would be nice to have a crystal ball at hand, but forecasting enrollment is not all guesswork. We can obtain fairly accurate results if we base our forecasts on sound survey methods, of which many have been devised. *American School Buildings*[35] lists five. They are:

1. Forecasting by first establishing a ratio between total population and school enrollment and then making use of population data provided by city planning commissions and other similar groups.
2. Forecasting by graphically projecting past school enrollment data into future years.
3. Forecasting by making use of the list of new telephones in the community and translating these data into estimated school enrollment.
4. Forecasting by analogy through making use of the percentages of total population attending schools in comparable communities and applying these to the local situation.
5. Forecasting by first establishing a per cent of survivorship between the various grades, and then applying these constants to present enrollment figures for each grade.

In some cases it is advisable to use all five of these methods, and more if available, because it is very important to establish the number of children to be served in future years as accurately as possible. It has been the author's experience that when the patrons question the accuracy of enrollment forecast, the best data to have on hand to back it up is a count of the pre-school children. These little children are more than statistics to these patrons who live in a block full of them. Unfortunately, only five states (as recorded in 1945) require the counting of pre-school children. As a result, this instrument is not available to the majority of school planners. But with proper legislation or an established policy by each school district, every district could have a continuing school census beginning with the enumeration of children at birth.

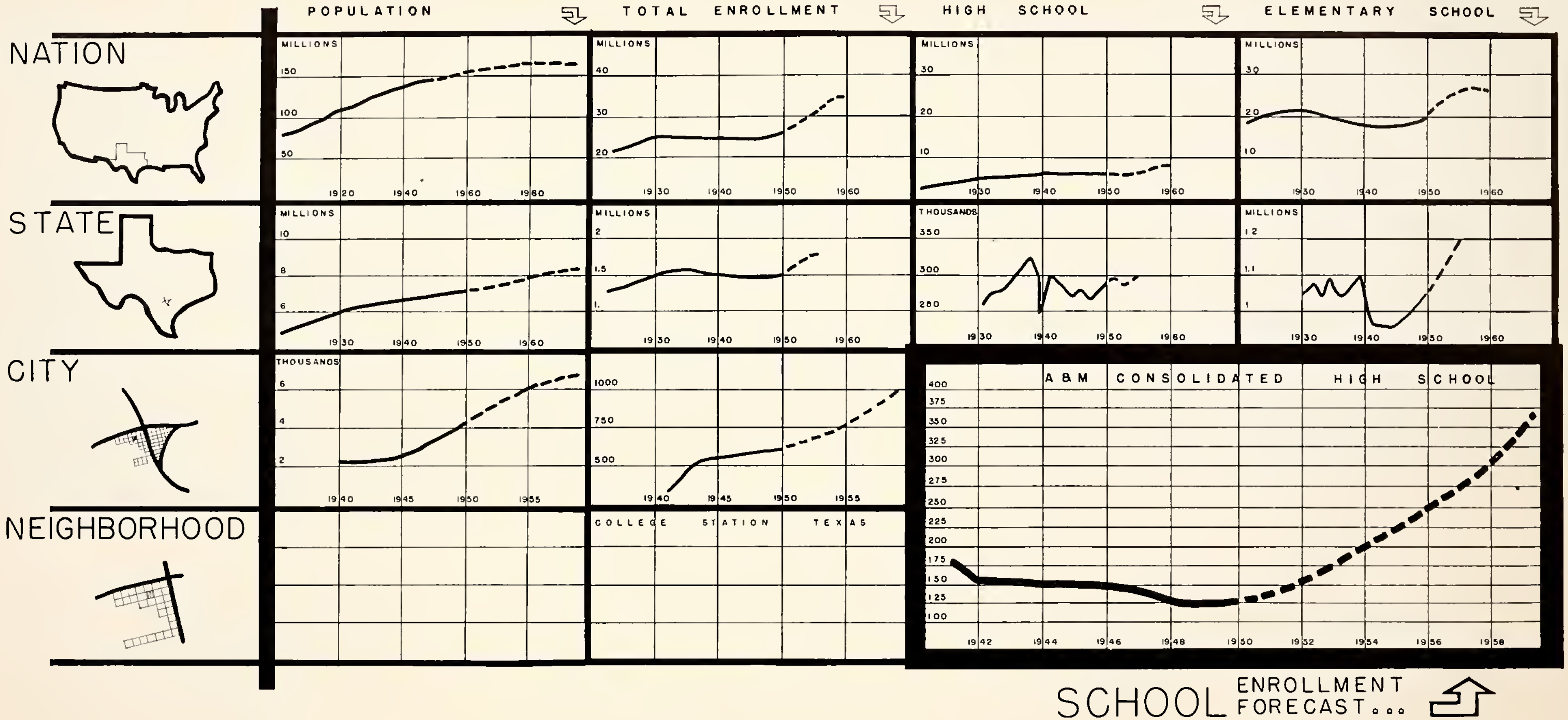
Because of the high value placed on the pre-school count, it is recommended that such a survey be conducted in any event, even if the children themselves must do it. Of course, the advisability of using children to help make surveys has been questioned by certain groups. Superintendent R. R. Russell of Stillwater, Oklahoma, believes in making use of school children for such surveys and he has years of continuous building programs to back him up. He explains his methods and his belief in it this way: "A unique feature of the pre-school survey was that it was conducted by school children. The district was divided into the three areas served by the three existing elementary schools. Each principal divided the school area served among all fifth and sixth grade teachers. Each teacher assigned a block to one or more children. A simple form was given each child, and a careful check was made by each teacher that the survey was complete in each block. So assiduously did the children work at this task that they would return time after time, and day after day, to a house from which they received no response. This method of survey served a triple purpose: it was economical; it was good civic training for children; it advertised in every home the purpose for which it was being



City Planning Considerations

118. In city planning, education is one of the ten great planning considerations. The three common denominators for all of these considerations are land, people, and money.

Forecasting the Enrollment for a Small High School



119. This chart, taken from *Your Schools*[28], shows how one community projected its high school enrollment. The top horizontal column shows predicted growth of the nation; the second horizontal column shows predicted growth of the state (in this case, Texas); the third horizontal column shows predicted growth of the community (College Station, Texas); the fourth horizontal column is for growth data of the neighborhood . . . since all facilities at College Station are located on one site, this column was not used . . . and the heavy square at the lower right is for past and predicted growth of the school in question (in this case, the A & M Consolidated High School). Note that the growth of nation, state, and city is reflected in the predicted enrollment of the high school. Superintendent L. S. Richardson, who made this forecast, has this to say about the fluctuating past enrollment of A & M consolidated high school: "Low high school enrollment for 1947-1948 and 1949 can be understood if one studies basic live birth figures for depression periods." For the average community, this method of prediction seems feasible, but it should be remembered that the enrollment of some communities, "boom towns" for instance, is not affected materially by past enrollment trends of the nation and state. The graph which shows the nation's population growth is based on data found in "Forecast of Population of the United States, 1945-75," by P. K. Whelpton, U. S. Government Printing Office, 1947. The graph which shows the trend in enrollment of the nation is based on data taken from "Our Desperate Need For More Schools and What Can Be Done About It," *Parent's Magazine*, September 1948, p. 40-41. The graph which shows the population of Texas is adapted from "The Outlook For Population Increase in Texas," by Henry S. Shryock, Jr. and Jacob S. Siegel, Bureau of the Census, *The Southwestern Social Science Quarterly*, September 1947. The enrollment charts for Texas are based on data submitted by E. L. Galyean of the State Department of Education. Mr. Galyean explains the fluctuations of the charts from 1939 to 1942: "In looking at the high school and elementary enrollment, it must be remembered that Texas changed from an eleven-grade to twelve-grade plan. The enrollment figures for those years are likely to be somewhat out of proportion, since we have no way of knowing which schools had the eleven-grade plan and which ones had the twelve-grade plan."

made. No adult or group of adults could have performed as complete a job as did these children. They wouldn't stop until every house in their respective blocks or areas had been canvassed."[28]

Other school administrators have had equal success by using older children, particularly the group in the high school civics class. And such surveys benefit the pupil as much as the school planner. It should be remembered that in getting this data on pre-school children, it is just as important to find out where they live as to determine how many there are. This will be discussed later in this chapter. But regardless of who makes the survey, or who interprets it, the job is there to do. And the more information which we can get to help us predict future enrollments, the better off we will be in formulating our school building programs.

As an example of how enrollment forecasts for a high school might be made, consider the case of the small school system of College Station, Texas. It had no research staff to make continual enrollment studies. The job had to be done by Les S. Richardson, Superintendent of the A & M Consolidated School District at College Station. Mr. Richardson started his task in this manner: First he secured data of the Bureau of Census concerning national population and enrollment trends, and he plotted these in simple, graphic diagrams. Next he asked the Texas Education Agency for a forecast of population and enrollment trends at the state level, because he knew that these figures, too, would be reflected in the local situation. Then he studied past population and enrollment figures for the College Station area. Although his primary objective was to forecast high school enrollment, he was particularly interested in seeing what was happening in the elementary grades because here was his best index to the future high school enrollment. By establishing a factor of survivorship for each of the elementary school grades he was able through simple arithmetic to predict how many of these elementary school children would reach high school during the next six years. But because he wanted to make forecasts beyond that time, he arranged with his teacher of social science to have the class in civics survey the pre-school children. The findings from this survey gave him a basis for extending his elementary enrollment figures, which in turn affected the high school forecast. He then evaluated all of the material on hand in terms of future high school enrollment and prepared simple charts which reflected not only past enrollment of the local community, but also the national and state enrollment as well. For a summary of his work refer to the accompanying charts. Is such a method really accurate? In this case it was, at least for the first three year forecast. Error? Richardson missed it by only 4 pupils!

We might not all be able to do as well as Superintendent Richardson, but our efforts at forecasting will be rewarded in some degree, because although planning for the future is something of a gamble, to ignore the future is a total loss. That is why every community should have a city planning commission, one which constantly is alert to population trends and will let school officials know of trends that may affect future enrollment and future distribution of the school population. This brings us to the discussion of the second major consideration of city planning—land. Now let us see how the consideration of land from the standpoint of city planning affects the school plant.

LAND—THE SECOND CONSIDERATION

When city planners talk in terms of the land, they generally speak of zoning, thoroughfares, and parks. Zoning simply means regulating land use and building use. Usually a city plan consists of separate zones for residential, commercial, and industrial buildings. It is no different from the zoning in a home which has a sleeping area, a living area, and a work area. It is obvious that schools should be located in the residential areas, free from dirt, smoke, and noise of factories and shops. Knowing in advance the location of factories and commercial buildings is a distinct advantage in school planning. A good city plan can give school planners such information.

The city plan also tells the location of proposed thoroughfares. Such information is highly desirable for school planners whose job is to locate new schools. Whether they like it or not, they have a moral responsibility, if not a legal one, for the pupil going to and from school. If a number of school children must cross a dangerous traffic artery on their way to school, is the school plant really a successful one, regardless of how wonderfully it serves the child during the school hours?

The good city plan also locates proposed parks. Both parks and school playgrounds should be located near homes. Both offer facilities for recreation and nature study. Why not combine them? Maintenance could thus be greatly reduced and shared by the park commission and the school board. The expense of the city playground supervisor could be eliminated since the school could take over the job. Also repetition of toilets and equipment storage would be unnecessary. If this is true, and there is every evidence to believe it is, then should not the long-range planning of parks and schools be simultaneous? City planning does it. See Case Studies 45 and 88.

THE SCHOOL SITE AND THE CITY PLAN

Now let us delve into this land study a bit further to see the implications that the land has upon the school plant, and equally important, the implications that the school plant has upon the land. For one thing, it is apparent that any area in which a school plant is developed is going to be altered simply because of the school's presence. In the first place, the value of surrounding land is certain to go up, with varying effects

on different kinds of other enterprises in the neighborhood. And in the second place, the nature of the area will be subjected to change. Since our children almost all live at home while attending school, their parents are naturally vitally interested in renting, buying, or building homes near the school. For this reason, the location of schools, especially in outlying areas, has often directly influenced the direction of a community's growth.

On the other hand, far too many communities offer excellent examples of how improper or nonexistent city plans have affected schools. It is common to find schools crowded onto bare cinder lots hemmed in by busy thoroughfares and battered by the din of heavy traffic and nearby industries. Nothing is right about these schools. The children cannot possibly learn well in them or play around them, and their location is too dangerous a place for the children to get to anyway. They are designed so that they cannot be expanded to meet a mounting enrollment, and are so cramped they could not be expanded if their design were flexible. Besides that, both the schools and the land wasted on them are nearly always far too expensive.

But so long as there are no city or regional plans such schools will be common; school boards will continue to pay too much for too little land on a block that has no virtue other than its central location. Or they will pay a reasonable price for more and perhaps enough land in a less convenient spot, and hope that the area develops without a factory or a new highway just outside the classrooms.

Sometimes, of course, far-sighted school boards have got together with city officials and local industrialists and business men with happier results. They have been able to figure possibly good future locations in advance and by purchasing in an undeveloped area at a time when prices were low, have saved the tax-payers a lot of money. Sometimes this kind of procedure pays off.

It would always pay, for school building and other kinds of developments as well, if the element of guesswork were eliminated. And there is no reason why it should not be done away with. It seems perfectly clear that if they recognize the existence of a community interest, planners of all kinds must realize that designing individual buildings without regard for that community interest is a haphazard and wasteful business. It seems clear also that a way to provide for future development, to insure good value for money spent, and to guarantee an uncluttered, sensible, and attractive city, is to have a master plan for everyone to use as a planning guide.

ZONING FOR RESIDENCES, SCHOOLS, AND PARKS

In connection with the matter of zoning, and in pleasant contrast to the prospect of a dingy square school building huddling grimily in the center of an ugly cinder-covered block crowded by industrial plants and befogged with sooty smoke, there is a fairly recent and pleasantly fortuitous trend toward combining schools and parks. Why? The reasons bear repeating. Both should be located near homes. Both offer facilities for recreation and nature study. Both have to be purchased by the city, which can save appreciable sums of money by making fewer land purchases, by greatly reducing maintenance and sharing it between the park commission and the school board, by eliminating the expense of a city playground supervisor, and by doing away with duplication of toilet and storage facilities.

Generally about one-tenth of the area of a community should be set aside for schools and parks, but anyone really interested in seeing that either schools or parks, or the two combined, are provided for will have his work cut out for him in most communities if he is to have any effect at all upon "the crazy quilt" pattern of development by private investors who want to get the largest possible profit out of the tracts of land they own on the edge of town. Most of these men are quite unaware of the financial gains they and the community can derive from such planning. They do not realize that land valuation in residential areas is much greater in the vicinity of schools and parks, and they commonly are not patient about learning.

The wise developer will provide land for schools and parks within a maximum radius of three-quarters of a mile of all homes. In turn, the wise school board or park commission (or the two in coordination) will try to anticipate the growth of even the unplanned community, and purchase sites for schools and parks while land is cheap rather than wait for land prices to skyrocket when their needs are pressing.

An additional factor, one that affects the directions of community growth, and for that and other reasons must be considered in selecting a school location, is that of natural and artificial boundaries. A town will not expand across swamps or rivers, or enclose deep quarries, or climb steep mountainous slopes if it has any alternatives. By noting these boundaries, the school board can more easily predict the direction of community growth and thus avoid buying land in areas destined to remain undeveloped.

One final question subsidiary to the selection of a location is that of schools and streets. Is a proposed site on a busy thoroughfare? Is there a through-highway or a railroad track near the site or between it and the homes of some of the students? If so, the site is undesirable no matter what its virtues. No school board has either the right or the desire to endanger the lives of the children. Wherever the proposed school is finally located, it must be in a quiet area without a traffic hazard.

In the smaller cities and towns where no city plans are available, the school boards will simply have to rely on good guesswork and take a chance that their new school will escape the common fate of being hemmed in within

a few years by business houses and factories. The blame for such catastrophes cannot be placed on the school board, which can hardly be expected to be clairvoyant; it must be placed on the short-sighted community, whose lax zoning ordinances preclude successful school building programs.

SEVEN STEPS FOR LOCATING THE SCHOOL PLANT

Where should schools be located? Though this by no means is the only question about land to be asked, it often seems to be because it is so troublesome. School boards and school administrators have fallen out seriously over it. These two groups have united in battle against various groups of property owners so that whole towns have been upset by this question. And almost always the results of either battle have been a legacy of bad feeling and a school located somewhere other than the best place.

This unfortunate situation is the exclusive property of unplanned communities and is basically the result of a combination of short-sighted self-interest on the part of some contestants and an understandably hazy conception of the requirements of a good location in the minds of others. The well-developed city plan has already solved the problem of where to locate schools and has done it in a way to avoid group conflicts. These city planners too started out with some confusion about the requirements of a good site, but they were allowed the freedom from pressure and the time to study the problem, to realize its complexity, and to designate future locations after incorporating answers to all closely-related questions.

But the main question itself has not yet been answered. Perhaps the best way to answer the question of where schools should be located is to recognize the complexity of the question and to follow some such deliberate, organized procedure as the seven steps in selecting a good school site enumerated on the pages following.

These steps (Fig. 120-126) taken from *Your Schools*,[28] offer a reliable course for the proper selection of school sites as well as a mass of helpful material. If a local school planning board represents its findings in simple maps and charts as shown here, it will find it easier to select a location, and it will have convincing evidence to offer the people if their aid is needed to rule against selfish interests interfering with the selection.

HOW LARGE SHOULD A SCHOOL SITE BE?

School planners cannot answer the question of where to locate schools without also answering another question: How large should a school site be? In the unplanned community, the size of a school site is too often determined by accident. That is, the land is bought and the school built without this question ever having been asked.

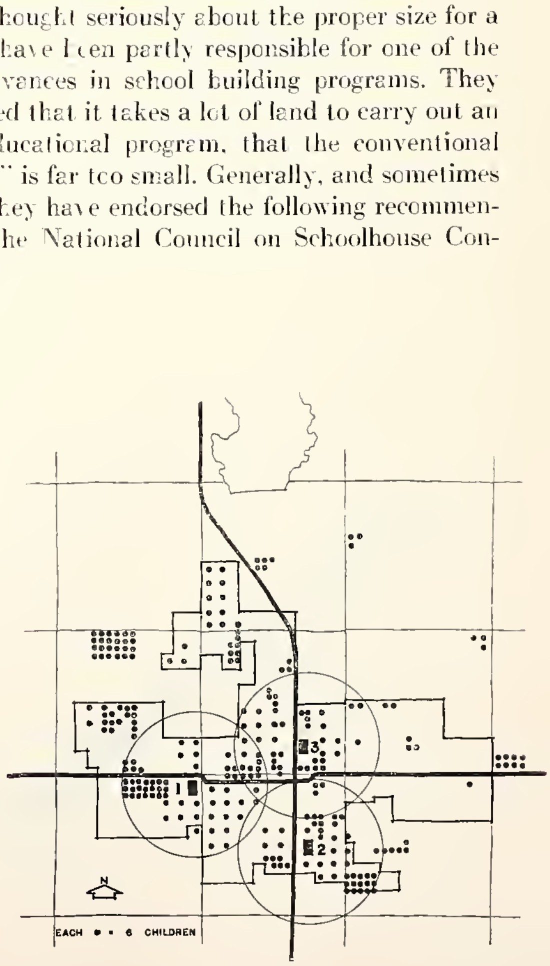
Precisely how large a school site ought to be depends upon a number of variable conditions in each case. But architects and educators rely always on three basic elements:

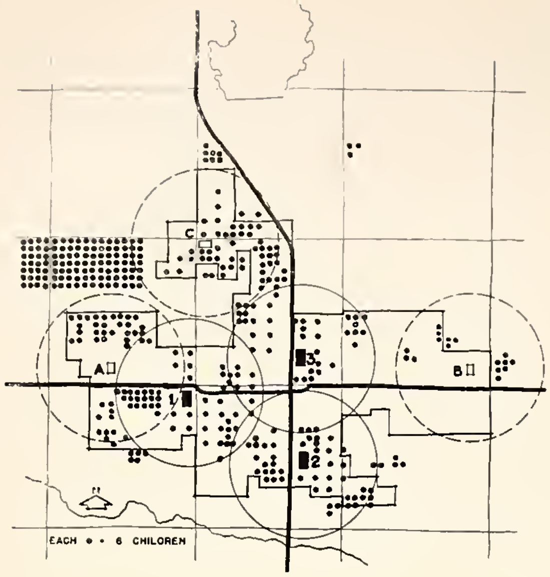
1. The kind of educational program to be followed in the new school.
2. The ages and classification of the students.
3. The number of children to be served.

And school authorities throughout the United States who have thought seriously about the proper size for a school site have been partly responsible for one of the greatest advances in school building programs. They have realized that it takes a lot of land to carry out an effective educational program, that the conventional "city block" is far too small. Generally, and sometimes wistfully, they have endorsed the following recommendation of the National Council on Schoolhouse Construction:[2]

Find Out Where the Students Live

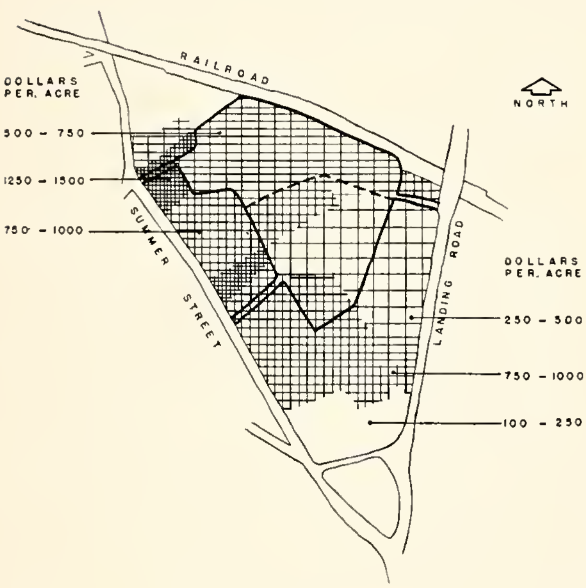
120. Go to the school records, find the location of each student's home, and plot it on a map. The geographic center may suggest a possible site, but certainly before you make a final selection you should consider all of the factors of the following steps. This map resulted from a survey of Stillwater, Oklahoma. In the vicinity of each dot live six school children. Superintendent R. R. Russell supervised the survey, assisted by Wilber, Caudill, Rowlett, and Scott, Architects. Compare this map with the adjoining one in Step 2. The black rectangles 1, 2, and 3 show locations of elementary schools. Circles have one-half mile radii.





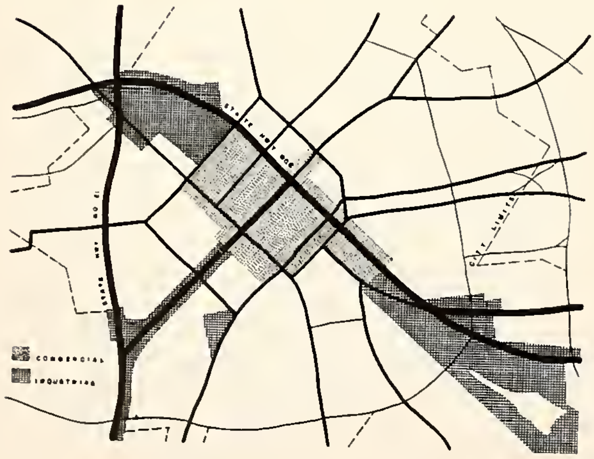
Find Out Where the Pre-school Children Live

121. To obtain this information a house-to-house survey is probably necessary. In this long-range picture this information is often more important than the data obtained in Step 1. The survey can be made by paid surveyors, or by local teachers or citizens. There are cases where the children themselves have made excellent surveys when properly guided. Heads of pre-school children were actually counted to get this map shown above of the Stillwater Survey (see map in Step 1). The survey method used is unique; refer to Superintendent Russell's comments on page 119 of this chapter. Rectangles A, B, and C show possible new school sites which may be necessary when these children enter the first grade.



Find Out What Land is Available

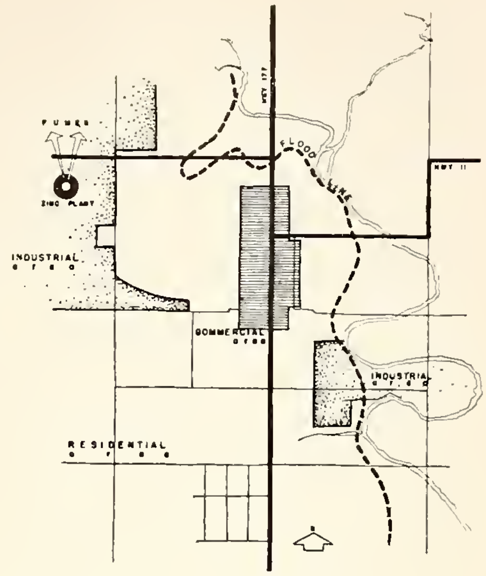
122. The usual procedure is to determine exact lots that are available and to establish their value. Comparative land values obtained from the local tax assessor are quite valuable in appraising future sites. These values, when super imposed upon a map, give an excellent over-all picture of the situation. In 1946, a group from Harvard, led by Walter F. Bogner, Dana M. Cotton, and Ralph D. McLeary, conducted a survey of school building needs for Kingston, Massachusetts. This map shown above was adapted from their report. It shows land value of an area which contains a possible new school site. It was believed that this area might be a feasible location, because of an existing playground; however, after calculation of land values, it was found that the site would be too high to produce any substantial saving.



Check Up on the Zoning Ordinances

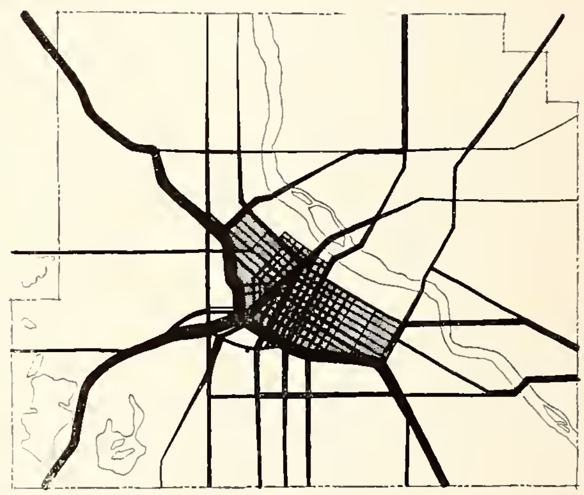
123. Before final selection of the site is made, make sure that the area is not within or adjacent to a commercial or industrial building zone. A boiler works or a honky-tonk across the street from a school does not provide an ideal setting. Most communities have zoning ordinances, and you can obtain copies at municipal offices. Maps like this one which shows commercial zoning (gray tone), industrial zoning (dark tone), and residential zoning (light area) aid in the selection of school sites. It is best to have schools located in the center of residential area. The map shown here is for Bryan, Texas.

Determine the Boundaries Which Might Hinder Residential Expansion



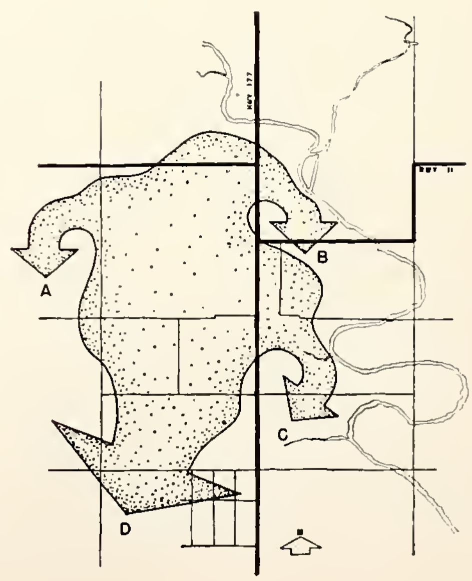
124. The growth of every community is limited by the location of such natural and artificial boundaries as rivers and lakes, swamps, mountains, quarries, and railroad tracks. Consider these boundaries in selecting the sites. This diagram above shows boundaries which undoubtedly will affect the growth of Blackwell, Oklahoma. A zinc plant on the west end of the city, the river on the north and east, and the industrial area in the southeast are barriers for residential growth. This is taken from a survey by a group from Oklahoma University's Survey Staff; Caudill Rowlett, and Scott, Architects; and Superintendent J. Arthur Herron.

Study Traffic Patterns



125. The school planner should be as much interested in what happens to the school child between home and school as he is in what happens between classrooms. School children die in great numbers because they have to cross busy thoroughfares between home and school. Taxpayers pay thousands of dollars each year in salaries to men whose sole duties are to escort children across busy streets. Generally it pays to select school building sites near the centers of quiet residential areas. Also, the planner should remember that the ideal elementary school district is one bounded by heavy traffic arteries rather than divided by them. In making your final selection for school sites, be sure to give traffic patterns careful consideration. Traffic flow patterns such as these often help in the location of schools. Children should not have to cross busy thoroughfares on their way from home to school. This diagram was adapted from material prepared by the City Planning Commission, Minneapolis, Minnesota.

Determine in Which Directions the Community Will Grow



126. Which way is the town moving? You must know before you can properly select school sites. You can save money, too, if you can anticipate the directional growth of the community. Generally, land is cheap in thinly-populated districts, but when this same land becomes densely populated the cost sky-rockets. Here is one of the greatest benefits of long-range planning—you can buy your school land when it is cheap. Here is another diagram from the Blackwell Survey. By noting barriers of population growth (see diagram in Step 5), such as the zinc plant at A, the flood line at B, the industrial area at C, the planners could clearly see that the only possible major development could be to the south at D. (The area north of A is undesirable for residences because of fumes from the zinc plant).

"For elementary schools, it is suggested that there be provided a minimum site of five acres plus an additional acre for each 100 pupils of predicted ultimate maximum enrollment. Thus, an elementary school of 200 pupils would have a site of seven acres. For junior and senior high schools, it is suggested that there be provided a minimum site of 10 acres plus an additional acre for each 100 pupils of predicted ultimate maximum enrollment. Thus, a high school of 500 pupils would have a site of 15 acres.

A lot of space? These are not grandiose dreams; they are standards recommended as *minimum* by qualified experts after a searching study. Even more land would not be wasteful. Lawrence Perkins, one of the nation's great school architects and the son of a famous school architect, insists that never in his experience or his father's has there been a school site too large.

School boards, by the way, should not object to a large site, for land is the cheapest thing they can buy. In fact, in most situations they cannot lose, because the minute they obtain a deed to a piece of land, the land surrounding it jumps in value. Moreover, if they look ahead and buy land while it is cheap in areas which will need school buildings in the future, they can save thousands of additional tax-payer dollars.

Probably the most accurate and most logical way for school planners to determine the amount of land they will need is to follow a planned procedure:

1. Determine what kind of an outdoor educational program is desired.
2. Lay out the space requirements for each activity
3. Estimate the ground space required for buildings, drive, and parking areas.
4. Total these requirements and consider the total as an absolute minimum to be modified further by the shape, contours, and natural characteristics of each proposed site.

The sketches on these pages suggest the amount of space certain typical facilities require even when crowded into the smallest possible area. They make it obvious that the usual "city block" is in truth ridiculously inadequate.

These sketches also show that the size of the site can very easily govern the design of the school building. Refer to Case Studies 3, 15, 21, 49 and 75. In one recent case in Oklahoma everyone concerned preferred single-loaded, finger-plan designs for the two schools to be built, but the extremely limited sites forced the erection of very compact, double-loaded corridor schools. Furthermore, because of this limitation one school had to be placed with its axis perpendicular to the prevailing breeze and the other with its axis parallel to the wind, making the natural ventilation problems very difficult to solve.

A community's school board might not be able to get a site the proper size, but it should try. The smaller the site, the less freedom the architect has and the less effective the resultant school will be. Certainly the question of size ought to have a great deal to do with finding an answer to the problem of location.

WHAT SHOULD SCHOOL SITES BE LIKE?

The discussion to this question might well have come in Chapter 2 under the heading of education, but since it bears close relationship to the location and size of school sites, it is included here. This question—what should a school site be like—should be studied most carefully, precisely because it is so often not considered at all. Those concerned often become so engrossed with the practical business of acquiring enough land somewhere near a good location at a good price, that they forget a very pertinent fact. Children, just like the rest of us, do not function in complete independence; we all work better or worse according to our environment, and even in connection with a fine, well-equipped new building, a couple of acres of cinders is not a suitable environment for learning.

If Russell Wilson, who was mentioned earlier, has his say, every school site would have a small lake, hills (even if they are bulldozer-made), and lots of trees and grass and rocks. He points out that these could be used for nature study, and insists that children have as many learning experiences outside the classroom as they have on the inside. And so far as the writer is concerned, there is much to be said for this point of view. His young daughter spends countless enjoyable hours playing and learning from nature in a park adjoining a lake near her home. Think of the enjoyment a youngster of the early grades gets from playing on a little hill. It beats expensive playground equipment. The author still has fond memories of his junior high school days in Oklahoma City when he and his classmates played "keep off the hill" in the spring and "sledding down the hill" in the winter on a wonderful hill located on the school site. The same hill was used as an open air theater. The school board received much for its money on a piece of land that could not be used for anything else but informal playgrounds. The trouble with most school planners who are looking for school sites is that they fail to see the value of "rugged land, not fit for school buildings or athletic fields." They sometimes go to a lot of trouble and expense in making a wonderful park-like site look something like the prairies. It is true that a good school site should have open space for organized games such as football and baseball, but it is also highly desirable for it to have some wooded areas, hills, rocks, and even water.

This discussion could not be complete without drawing from the broad experience of that great educator, Dr. N. L. Engelhardt Sr., whose contribution to the educational aspect of school architecture is unequalled. Of the many site selection situations throughout the

country in which he has had a hand, he talks about one in Maryland to drive home the fact that a school site is an educational asset. By letter Dr. Engelhardt says:

> In Montgomery County, Maryland, Dr. Edwin Broome, the Superintendent of Schools, and I, working together over a period of years, selected many large school sites for both elementary and secondary schools on which nature had bestowed various bounties. We sought sites that had brooks and beautiful trees; variations in contours and different kinds of natural growth. Dr. Broome delighted in these wonderful outdoor instructional spaces, where children, having studied the evil effects of erosion in their classrooms, learned from first-hand experience, to control the erosive impact of heavy rains on the school's contours, or, having studied the city plan of Washington, D. C., in texts and on wall maps, set themselves the task of replanning L'Enfant's city on a quarter acre of the school grounds.
>
> It seems to me that the building, its utilities, its materials of construction and the character of the craftsmanship that entered into its construction, offer unlimited opportunities for instruction. Perhaps even a simplified book of its working drawings and a companion book of simplified specifications, would become more illuminating texts than some now listed as required reading. In like manner, the school site, if adequate in size, offers boundless opportunity for learning laboratories close to nature and the environment of the locale.
>
> As teachers learn to use these facilities inherent in buildings and sites, and as architects conceive of ways and means of planning to induce more constructive instructional use of their plants, school building centers will take on new meaning. The future school will not be just a congeries of geometric spaces set aside for instruction, but it will encompass the entire environment, building, site, and all that man has contributed to their usefulness.

But there is more in such a school site than even this undeniable value. The peace of mind and soul that comes to all of us in quiet, shaded, restful surroundings is not something to be denied our children if we can help it. Some of us have built our homes in such surroundings because we do recognize this value, and the rest of us dream of someday retiring to such a place. Children, no less than we, yearn for and deserve the blessings of nature. And being younger they are more susceptible to its virtues. They are happier and learn better in that environment.

There are limits, of course, to what any group of planners can do to get a park-like site, but they should not allow themselves to forget that the characteristics of a site are just as important as location and size.

The best any group seeking a site can do is to pick a site which seems the best compromise available. It might be necessary, for example, to make do with a flat, four-acre plot for an elementary school because it happened to be available in a good location. On the other hand, the group might find no available land of any decent size anywhere near the best spot, and decide to build the new school on an outlying acreage picked for its beauty, re-investing the savings on land cost in a school bus system.

THE NEIGHBORHOOD UNIT—A SCHEME FOR PLANNING CITIES

The greatest contribution of city planners to school plant planning is the concept of the neighborhood unit.[37] In essence the neighborhood unit is a scheme for the perpetuation of the family-life community. It is an answer to the inhuman manner in which most of our cities force us to live. Architect Charles Granger, one of the architectural leaders of the nation, is fully aware of the great value of the neighborhood unit when he says, "If we are to regain human values in our planning, and if we establish human scale and the individual as the module for our planning, then the neighborhood which centers around community interests, and which has as its focal point the elementary school, is our natural basic planning unit. The size of the neighborhood will be determined by the distance a child may comfortably and safely walk to school and the population required to ensure an optimum enrollment in the school. The integrated nature of the neighborhood thus created will foster a feeling of friendliness and cooperation, and will instill in all its residents a sense of civic pride and responsibility."

The neighborhood unit is based upon six principles:

SIZE OF UNIT
The size of the unit should be enough to constitute one elementary school district.

BOUNDARIES
The unit should be bounded by thoroughfares, not divided by them.

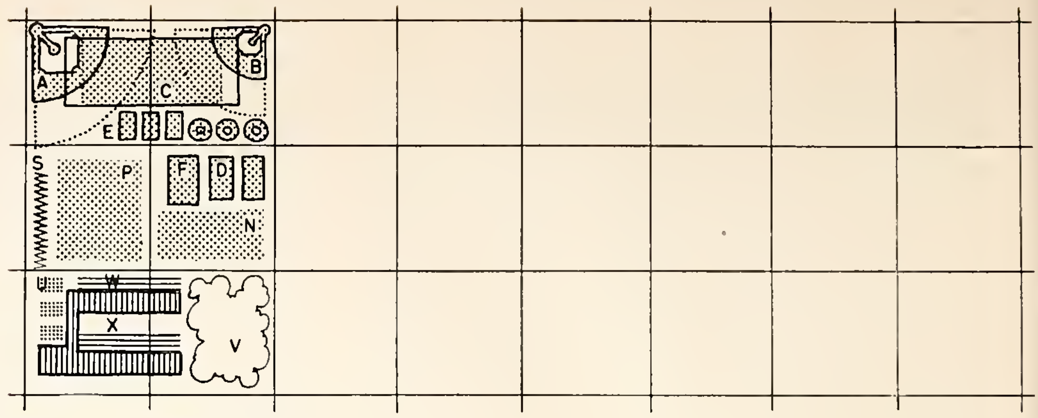
RECREATIONAL SPACE
The unit should provide for recreational space, often combined in park-school combinations where children and adults alike can learn and play in a spacious, sylvan environment.

SHOPPING CENTERS
The units together should provide shopping centers at convenient distances from the homes, and usually at the intersections of the main bordering thoroughfares.

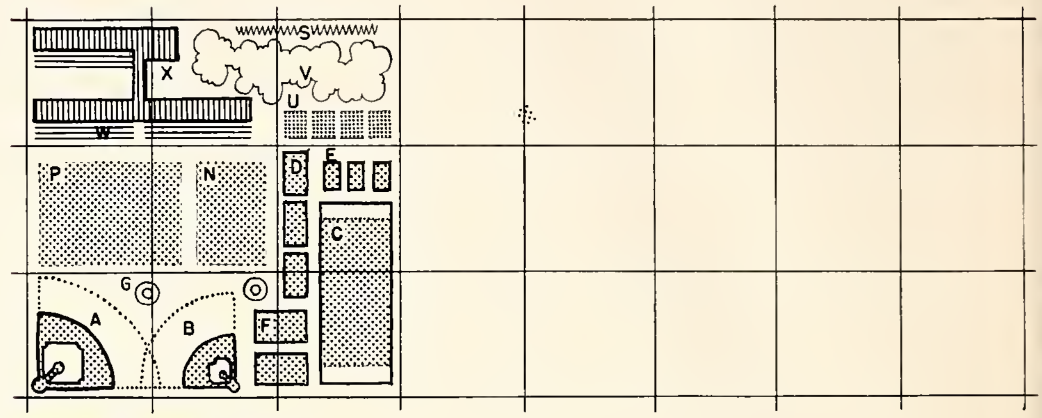
SCHOOL SITES
The unit should provide a center grouping for sites for the school and other institutions having service spheres coinciding with the limits of the unit.

STREETS
The internal street system of the unit should provide streets designed proportionally to their probable traffic load and arranged to discourage through traffic within the unit.

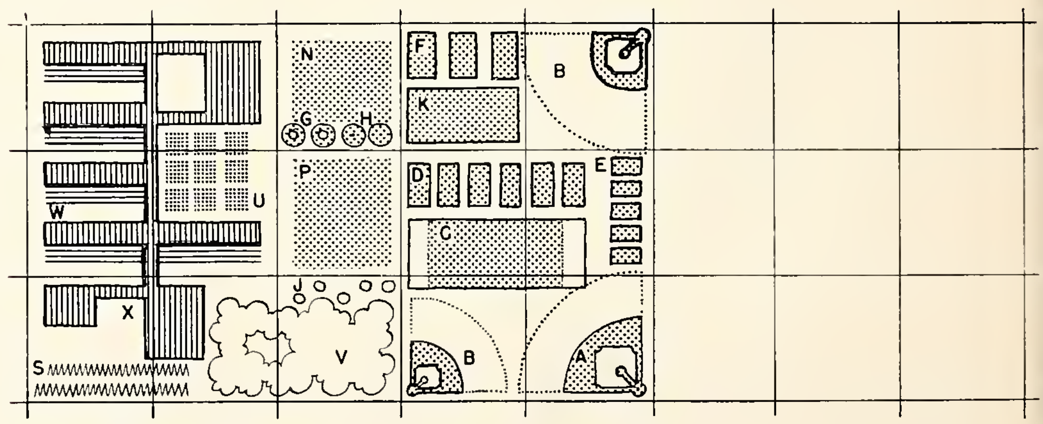
Utilizing the Site: Elementary Schools



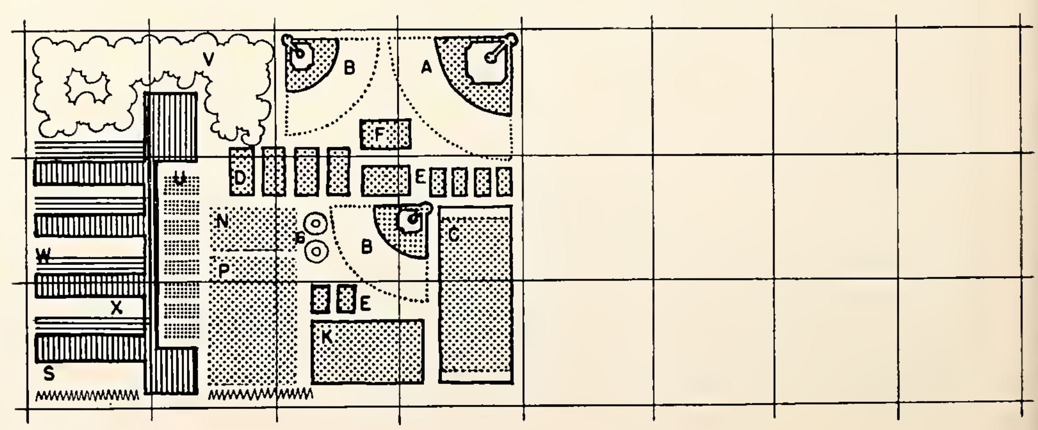
Elementary School—6 Acres



Elementary School—9 Acres



Elementary School—12 Acres

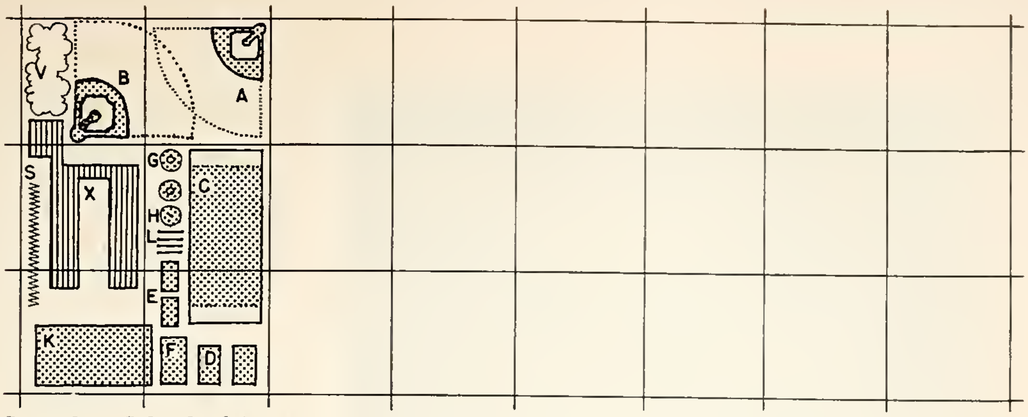


Elementary School—15 Acres

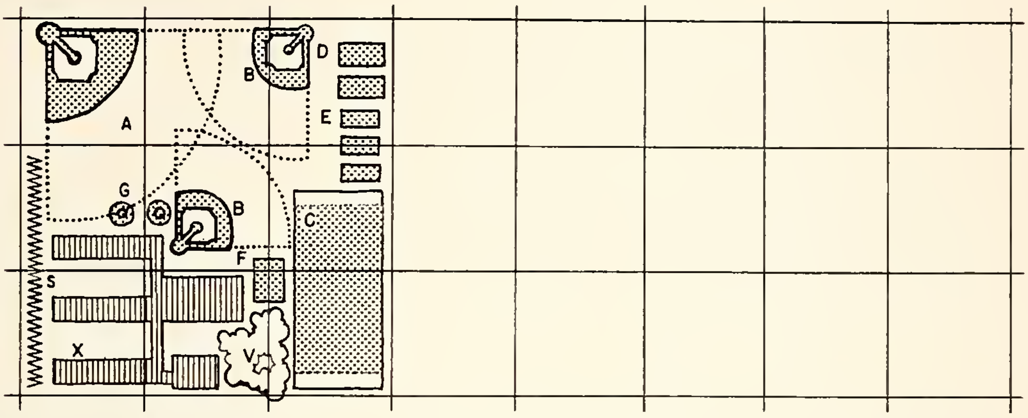
Utilizing the Site: Secondary Schools

127. Legend for Diagrams

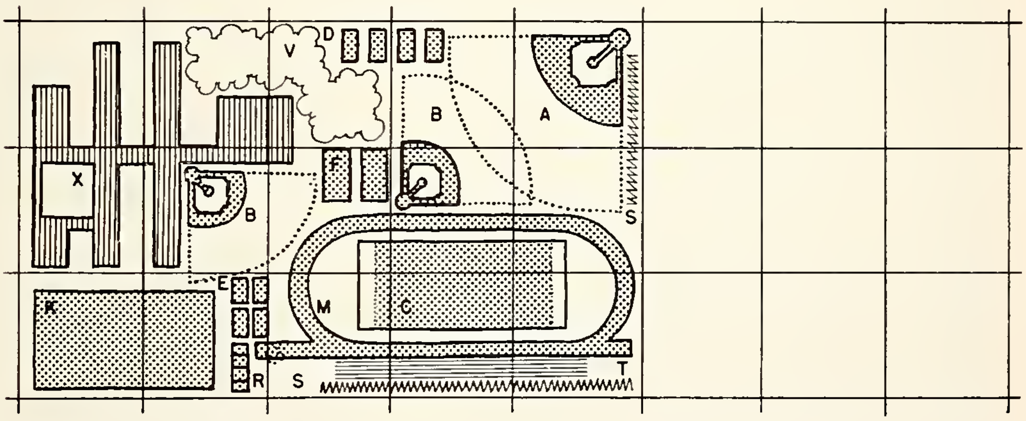
baseball	regulation	A
	junior	
softball	regulation	B
	junior	
football	regulation	C
	touch	
tennis		D
volley ball	regulation	E
	junior	
basketball		F
goal-hi		G
giant stride		H
marble ring		J
soccer	regulation	K
	junior	
horseshoes		L
track and field events		M
apparatus		N
low organized field games		P
gold putting green		Q
handball		R
parking		S
seating		T
gardens		U
nature studies		V
outdoor classrooms		W
classrooms and buildings		X



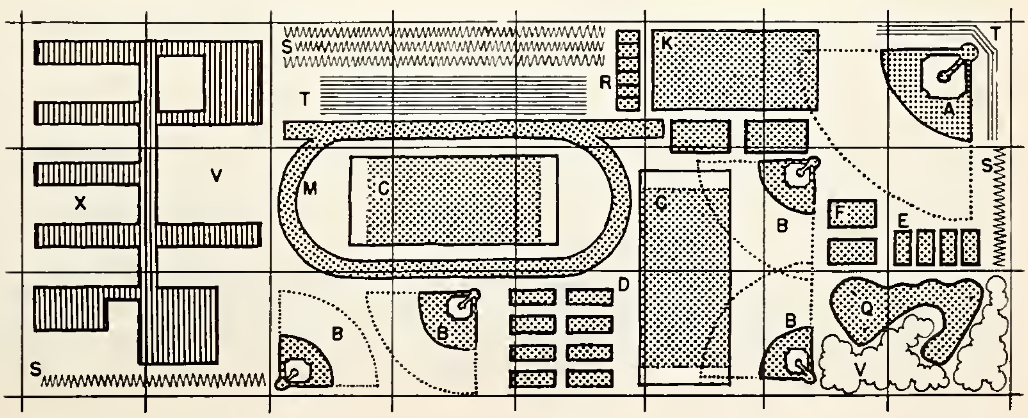
Secondary School—6 Acres



Secondary School—9 Acres



Secondary School—15 Acres



Secondary School—24 Acres

128. Here is a diagrammatic sketch of a neighborhood unit based on five major elements: the school, the park, stores, major streets, and minor streets. The size of the unit is large enough to constitute one elementary school district. This sketch shows a cluster of three neighborhood units. The boundary of the units is marked by major thoroughfares. The recreational area is a part of the school plant. Shopping centers are conveniently located and grouped together in their relationship with other neighborhood units. The street patterns are such that students going from home to school cross only minor traffic lanes.

This wonderfully reasonable development of city planners can be better understood by studying the accompanying sketch illustrating these principles. The elementary school, centrally located and surrounded with park area, is easily accessible by and within walking distance for the pupils. Note how each unit, a cellular part of the city plan, is connected with another and shares shopping centers with it. Many American communities are making use of this basic plan. For example, in at least one city in the Southwest a residential area is being developed as a neighborhood unit in which most of the houses are grouped around a park (which has been planned in conjunction with the elementary school) in such a way that the majority of the pupils never cross a street, even a minor one, on their way to school. The neighborhood unit is planned to make life more livable and interesting for those who live in it. It has a comfortable school building where the residents may meet to work out their mutual problems, to be entertained by their children, to gather as a community in cultural pursuits. It has playgrounds and enclosed recreational space in which to relax all months of the year. It has restful parks to be used and enjoyed by everyone in the neighborhood, young and old. The neighborhood unit is a great plan, but not so great as to exclude the discussion of all others. Does it apply to all situations? What about the large cities? Can we tear down these and start all over? What about the rural communities? An elementary school district sometimes stretches over a 25-mile radius. We have reasons to think that perhaps the neighborhood unit does not apply either to densely populated areas of the established city or to thinly populated areas of the rural districts. Are there other schemes, then? Architect Charles R. Colbert seems to think he has found one, and the author is inclined to believe that he has. At least it is an example of fresh thinking in this approach to school planning, and for that reason alone it should be included in this publication. But its value is greater than just that. It represents another tool of city planning that can be used to help us get better school plants. Like the neighborhood unit, it has its roots in the master plan of the city or region.

THE SCHOOL VILLAGE—ANOTHER SCHEME FOR SOLVING THE SITE PROBLEM OF THE CITY

Colbert calls his scheme the "school village."[38] Here is what he proposes for situations like that in New Orleans, where he is the Supervising Architect for school planning and construction. He wants planners to build up suburban school villages of several school units on the outskirts of the city and transport the children from the crowded city area to these school units. What are some of the gains? He lists two main ones. The first comes under the heading of price and availability of land. He proposes to exchange the distance between home and school for adequate school sites. He reasons that since school sites cost as much as $150,000 per acre in many sections of New Orleans and since within a distance of six miles the land cost drops to less than $3,000 per acre, it seems logical to go to the outskirts to buy the land and take the enormous savings for bus transportation and for larger and better sites. As an example, he points out that in one small but densely populated section of New Orleans, there is an exigent need for eleven schools. The cost of acquiring neighborhood school sites in this area, based on nationally recognized standards, would cost more than $15,500,000. Six miles away, in the suburbs, a beautiful wooded site meeting these national standards was purchased for $300,000 for a school village. His estimate of the transportation cost of getting the pupils from home to school and back for the next 17 years was approximately $425,000. In this instance Colbert says, the cost of the neighborhood school with its 30 minute *walking distance* from home to school exceeded the cost of a suburban site with its 30 minute *riding distance* from home to school by almost $15,000,-000. There is no doubt about it, he presents a strong point.

He has another strong one in favor of his school village idea. Colbert says that in large cities such as New Orleans there is a great shifting of family population. School have been constructed in the past in areas where child population was heavy at the time, only to have the child population shift before the schools have lived out their usefulness. These schools that live only half of their potential lives are poor investments as far as taxpayers are concerned. He lists four in one region of New

Orleans that are only 40 per cent utilized because the children have finished school and have moved out of the neighborhood. Then he compares this "dead" area with new housing developments having dense school population now, but which will probably become "dead" in a few years. With the school village plan Colbert believes that schools can be made to serve their full lifetimes.

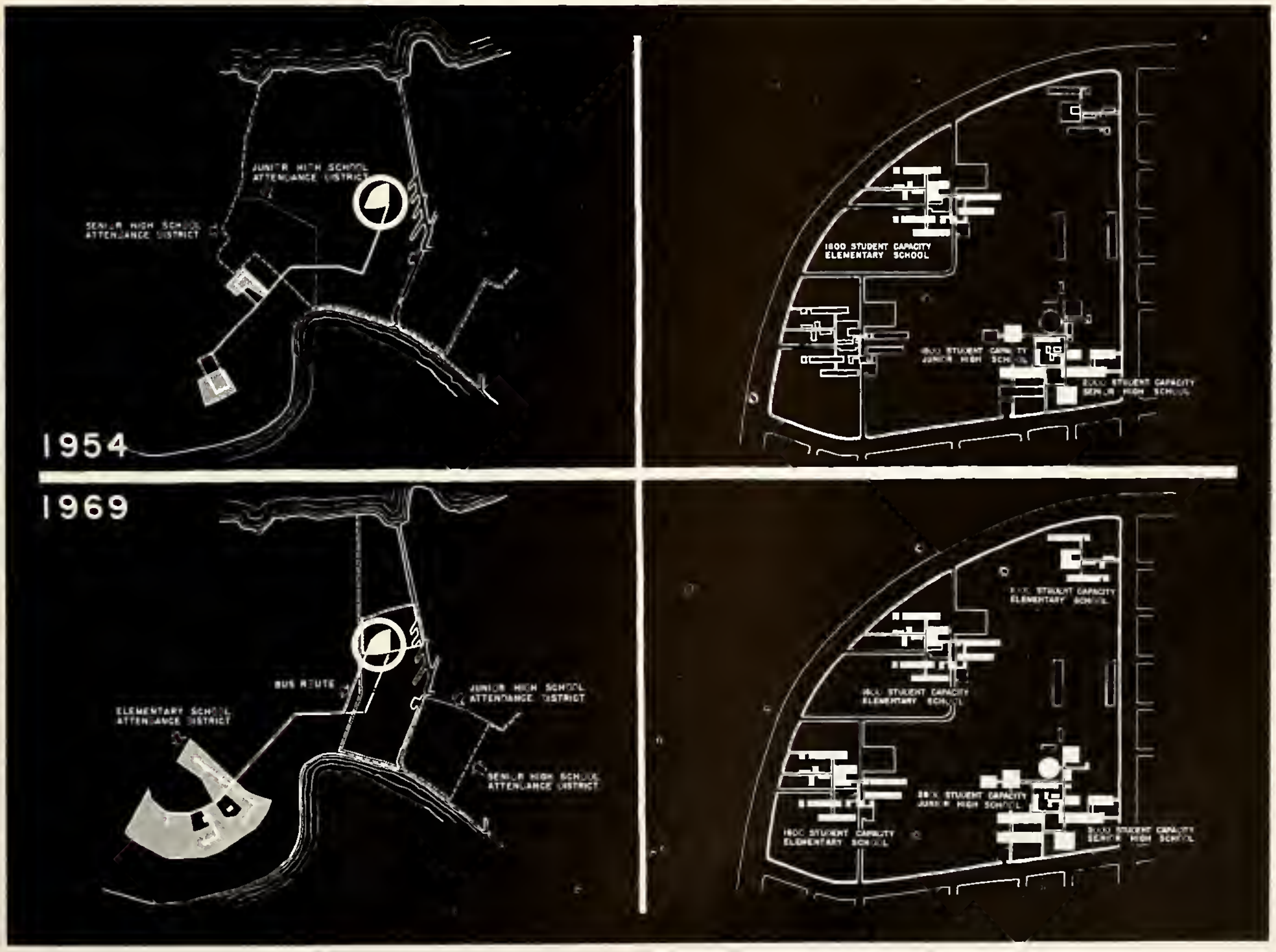
To say the least, it is a stimulating idea. School maintenance people should certainly relish the thought of a central plant and the economies of centralized heating, cooling, telephones, gas, and electric distribution as well as the economies and efficiencies realized by consolidated administration and record facilities, not to speak of the savings afforded by multiple use of assembly halls, kitchens, and the like. Yes, Colbert's school village is something for us to think about. We may not agree to his exact solution, but we shall have to agree with his approach to solving a very difficult problem. And again, it is the approach that counts. Once we as school planners find this approach, the solutions to our problems will unfold naturally in the form of beautiful, functional school plants.

THE SITE PROBLEM OF THE RURAL AREA

Rarely are there techniques of planning which will work for both the rural situation and the urban situation, but apparently the village plan idea can be adapted very satisfactorily to the thinly populated school district.

The School Village Plan

129. Here are sketches which explain Colbert's school village plan. He proposed to build a suburban school village on the outskirts of the city as shown in the upper left sketch. The scheme provides for transporting the children from the crowded city areas to these school units. The timetable of this plan is to build an elementary, a junior high, and a high school (upper right) and to provide sufficient land so that the school village may be enlarged to take care of three elementary schools, and an expansion of the junior high school by 1969. Although this scheme is controversial, it bears careful study because it shows that there is an alternative to the neighborhood unit scheme of school location.



In some respects this plan is similar to the consolidation movements of these past few years, in which groups of small individual school districts join into one large district and provide all facilities on one site. As soon as this country improves its rural roads, the consolidation movement will continue throughout the entire country. Good roads are the key to the problem. And perhaps good busses, too. Like everything else, school busses can be improved, of course. Perhaps they have been modeled too much after the general transportation vehicles. Designers of busses should study educational aims; then perhaps they might come out with something really worthwhile. There are too many pupil hours spent in busses for riding purposes only. Architect Colbert says that the future school bus will be equipped with audio-visual facilities and that learning activities will be carried on within the bus under the guidance of a teacher. There is no doubt about it, the school bus is beginning to fit more and more into the educational picture. And good roads and good busses have great bearing on the site problem of the rural area.

Let us examine a real situation. There is a little community near Dallas called Mesquite. Like most communities located on the fringe of a metropolitan area, it is growing fast, too fast to take care of its children properly. At the time of this writing classes in the Mesquite school district are being held in churches. The school district includes not only the little city of Mesquite, but also the surrounding area covering 20 or so square miles. Ninety per cent of the children come to school in district-owned school busses. An analysis of the current and immediate needs indicated that 36 additional elementary classrooms were needed.

Here is that problem that faced Superintendent T. H. McDonald and his school board. Should one or more schools be constructed? Thirty-six classrooms for one school seemed exceedingly high. Where should the school or schools be located? How much land would be needed?

Here is how McDonald and his school board solved their problem. First they purchased land—some 30 acres—on the edge of Mesquite, where cost was relatively low. The choice was excellent. About two-thirds of the site is level, splendid for recreational fields and building sites. The other third is park-like with lots of trees; it even has a small lake. It was a big decision to make, whether to buy two or three sites and place on them two or three small schools, or to buy this one large site and have one large school plant. But the decision was made in favor of the large central school plant for these reasons: (1) since the large majority of students comes to school in busses, it really did not make much difference where the site was located or whether the plan called for one school or more; (2) by securing one large site, a much more desirable piece of land could be obtained, (3) one unit would be more economical to operate. These are the reasons that Colbert gave, but the big question to the architects and to George Wilcox, who was called in to evaluate and criticize the basic plans was this. Could such a large elementary school plant be made to work from the standpoint of education? It was finally decided that it could if the large school were broken up into smaller ones. And that is just what the planners did. Refer to the accompanying sketch of the over-all layout.

During the long discussions which followed the purchase of this large site, one of the largest elementary school sites in the Southwest, Walter D. Cocking was asked to give his opinion on the situation. Dr. Cocking, as every reader knows, is one of the nation's foremost educational consultants, and a pioneer for child-centered school plants. Because of its visionary account, one of his letters of reply to this request is quoted here:

"It seems to me that your problem really comes down to . . . how can you provide suitable plant facilities for nine hundred or more elementary school children on one site and at the same time provide for suitable and necessary decentralization, privacy, and security for those children. A corollary problem is . . . what facilities should be provided which would bring together all of the children, or at least a major portion of them, and which of the facilities should be reserved primarily for various small groups." Dr. Cocking in his letter went on to point out the economy potential in such a proposal, and listed some of these common facilities which he recommended be placed in a central building. He then discussed the possibilities of the classrooms by saying, "Around this building, but situated some distance away and connected by suitable breezeways, I would have a series of small buildings designed to provide a quiet homelike atmosphere. In fact, I would have them look like houses as far as possible." Apparently Superintendent T. H. McDonald and his school board had the same sort of vision when they approached the problem of selecting the Mesquite site.

What rules of thumb can one use in this kind of site selecting situation? There are none. It takes vision and good judgment. It takes a fresh approach, the kind that produced the neighborhood unit. There is no point here in arguing the merits of the school village vs. the neighborhood unit. That would be just as fruitless as an argument over the finger plan vs. the compact plan. In fact, the comparison is very similar, only the scale has changed. There are places for all of them, and many more planning techniques like them.

CONCLUDING REMARKS ON CITY PLANNING

This discussion has had a heavy emphasis on city planning, but the emphasis is unavoidable in any discussion of this kind. The city and region simply cannot develop without regard for schools and even hope to have effective schools. And the schools themselves are by their very nature so essentially a part of the community's

Teaching and Learning Out-of-Doors

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130-134. The use of the outdoors for classroom teaching is becoming more popular every year; in fact, its popularity increases as the activity program reaches into more school systems. The reason for this is that teachers simply need more space for these activities, and the space beyond the classroom is as convenient and practical as any. Also, it is economical space. Here are examples of some classroom spaces designed for outside activity. If these kinds of outdoor teaching facilities are to be provided, the site should be selected to include the right amount and the right kind of space for them.

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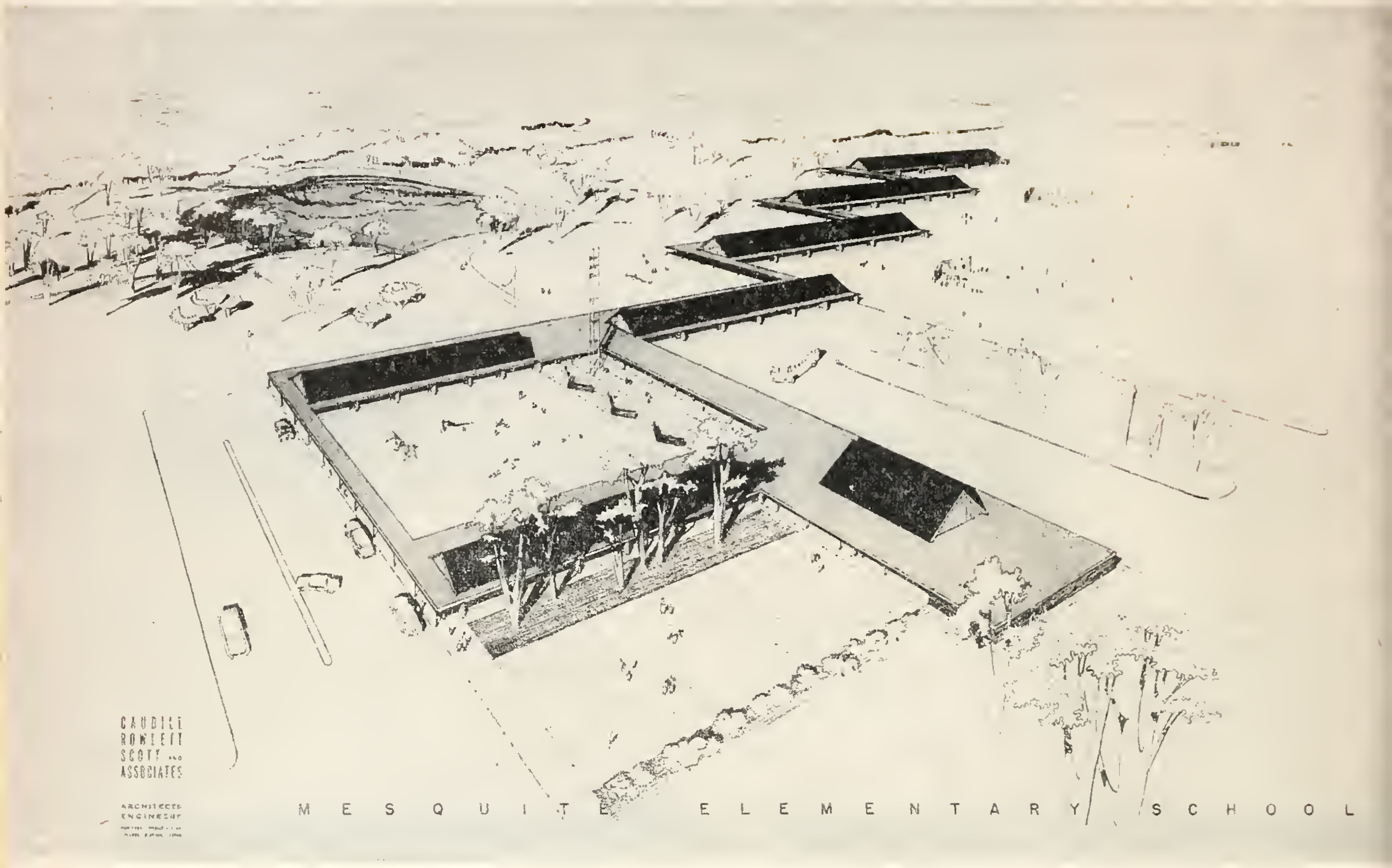
A 30 Acre Plot for a Large Elementary School



135. Thirty acres of land were purchased for this school, and every one of them will be used. Here is how: Because of the extremely large enrollment, the school was broken up into six small schools, each having its own playfield and park area. Grades 1 and 2 (6 classrooms each) are housed in the two wings on the left. Grades 3, 4, 5, and 6 are housed in the wings which are shown staggered. Note that each of these has direct access to individual playfields on the right, and each opens to a park-like area on the left. The park, which occupies about one-third of the school site, is for education as well as recreation. The pond is maintained for nature study. Since the large majority of classrooms open to the park, the park itself will be an outdoor laboratory. The variety of trees and plants will be classified as a school project. Playground equipment is not necessary because of the wonderful opportunity to play offered by the climable trees and hills. Paved ramps are provided over some of the hills for skating. The bus access to the school plant is separated from the usual traffic to avoid congestion, but unloading ramps are provided for both busses and cars of patrons. The building mass on the right houses the facilities common to all "six small schools," such as the administration suite, assembly area, eating area, and health suite. This proposed school is for Mesquite, Texas, T. H. McDonald, Superintendent; George B. Wilcox, Educational Consultant; Caudill, Rowlett, Scott and Associates, Architects.

life that they in turn cannot be planned independently of city and regional development. As school planners we must somehow develop this basic concept of the total environment—not just the buildings and the environment caused by its envelope, not just the environment caused by the school site, but the total environment created by the building, the site, and the community and region surrounding it. If we are to rise above mediocrity, we must rise above our individual schoolhouse problems to see the entire region. We must learn that the setting is almost as important as the building, and that great architecture includes both. We can conclude that the obvious and only effective way to have effective schools in an attractive, reasonably arranged community is through a long-range city plan that recognizes the importance of schools.

CASE STUDIES WHICH ARE RELATED TO CHAPTER 5

No.	*Problem*
3	How can a very small school site located in enormously expensive property be best utilized?
11	Can a school library be designed to serve the community as well as the school?
15	Can a double-loaded corridor school have adequate natural ventilation as well as natural lighting?
20	How can a school be designed for effective community use?
21	What are some architectural techniques of making multi-use of space?
22	Can combination of spaces be used effectively in small community schools?
45	Can elementary schools be zoned to satisfy functional requirements of both school and community?
49	Can an elementary school be built on a precipitous site?
55	How effectively can the site be used to enhance the beauty of architecture?
61	How can a school plant be designed for three phase development?
75	Is a campus school layout desirable for northern climates?
83	Can skylights be used for playsheds?
88	Can schools and parks be combined successfully to satisfy economical and operational requirements?

CHAPTER 6 DIVISION OF SPACE FOR EFFECTIVE EDUCATION

Architecture, among other responsibilities, is charged with enclosing a certain amount of space to be used for a specific purpose. It also divides this space, and this is the way in which most people normally think about architecture. Actually, of course, the matter of "floor plan" or layout is only one element of planning, and in the design of any plant it must be closely coordinated with all other factors—structural, functional, environmental, esthetic, and economic. But it is important enough by itself to merit a separate study. This chapter concerns the organization and integration of space within school plants, and the philosophy behind the detailed planning of functional spaces, with emphasis on approach rather than solution.

Space, therefore, is our subject. We shall talk about space to walk in, space for teaching, space for cooking and serving food and space for eating it, space for having assemblies for large groups of school children, indoor space to play in when the weather will not permit outdoor play, and space for administering the school plant. Why not be more specific and talk about principals' offices, gymnasiums, auditoriums, and cafeterias? For one thing, the principal's office is usually thought of as being a room, a definite enclosed space with a door, open or shut, to isolate this space from all other spaces. Maybe that is what we want; maybe the principal should be housed in a segregated little nook (oh, it could be a pleasant and private one) within the school plant. But maybe not. If we talk about rooms, our thinking is limited. A principal's office may be more or less than a room. It may be a space within a general service area. Or it may be an alcove off the main concourse. Does it necessarily have to have four walls and a door? Why should we talk about cafeterias? Would it not be better to talk about eating space? Is the so-called cafeteria the only solution? Why talk about the gymnasium? Is this pre-conceived pre-shaped architectural mass the only solution to the physical education problem? Quite probably there is a better solution. We know that stock plans for entire school buildings do not satisfy all conditions. For the same reason we should know that stock solutions to individual parts of school buildings are not final answers. Cafeterias, principals' offices, conventional classrooms, gymnasiums, and auditoriums as we think of them today are stock solutions. Have we arrived? Certainly not. There never has been a perfect solution to a problem of architecture, and there never will be. Thank goodness for progress. And if our generation is to forward the progress of school architecture, this we must do. *We must get rid of our limited conception of space.* Until we find out that a schoolhouse can be more than a collection of rooms tied together with halls, we hamstring this approach to architecture. We must find out more about space, and how we can use it effectively—for space is the medium of architecture.

THE FLUID QUALITY OF SPACE

The continuous and fluid quality of space exemplified by great works of contemporary architecture is unlike the space feeling of any architecture of the past. The new spaciousness of a Mies van der Rohe or a Frank Lloyd Wright house gives to architecture one of the most important innovations in modern design—the open plan.[39] A house with an open plan differs from a house with a traditional plan in that the open plan affords a free flow of space in the main living area, while the traditional plan cuts up this main space into box-like rooms—a separate cubicle for the hall, one for the dining room, and one for the living room. The open plan considers these three elements as parts of a compound volume, and provides for integration of these space elements; the traditional plan chops up the space into so many isolated cubicles. It is a real joy to experience the pleasant feeling of expansive openness afforded to occupants of these open plan houses. There is no feeling of confinement whatsoever. A small kitchenette, 4 ft. by 8 ft., seems ample in an open plan house, but in the traditional plan house a person standing in this small an area would feel as if he were standing at the bottom of a well.

The skilled architect, with his knowledge and appreciation of fluidity of space, can score economic gains by making small spaces seem large. But just as important, he can make large, unfriendly spaces appear small and intimate by placing free-standing screens at just the right spots, and by doing so he introduces an element

The New Spaciousness

136-138. One of the greatest advancements of architecture these last few years is the modern architect's broadened concept of space. He no longer thinks in terms of buildings' having to be subdivided into confining cubes; he now conceives his plans in terms of continuous and fluid quality of space. This new spaciousness has given educational architecture warmth, and a friendly non-confining atmosphere, as these three photographs illustrate. No longer are classrooms cages in which to work.

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of curiosity caused by the space which flows around such a screen. By the use of large glass areas he can make inner space seem to flow to the outside and fuse with the immeasurable space of nature. He can create vistas within the building envelope, the like of which only landscape architects formerly could do. He has done these things in houses. He can do these things in schoolhouses. The more skillful the school architect can become in handling this quality of space, the better are our chances for beautiful and functional school plants. We must develop more planning techniques to take advantage of the fluid quality of space.

THE VERSATILITY OF SPACE

Versatility of space is a product of necessity. Many years ago classroom space had no need for versatility. It had only one job to do—to surround the five rows of fixed desks—and that is about all except possibly to provide some space at the front of the room so that the pupil or teacher could stand by a blackboard. But education changed all of this, and now demands more from the classroom. As it has already been pointed out, in Chapter 2, the classroom space must have multiple uses.

Because of what has happened in the classroom space, school planners are finding out that other spaces can be just as versatile. And because of this knowledge of versatility the nation is confronted with an epidemic of multi-purpose rooms with all sorts of labels from cafetoriums to auditerias. Archibald B. Shaw, a leading educator in the East, saw fit to warn school planners of the misuse of multi-use rooms when he said,[40] "There are few, if any, universally good combinations. Each school's, each community's purposes and needs uniquely determine the combinations that will work in *that* community. The trend is toward such local, intelligently based determinations." So this quality of versatility of space can get out of hand. But can we not make it work for us? Why not put it to work in the corridors which are used only for walking? Can we afford space just to walk in? Some schoolhouses have as much as 28 per cent of their floor areas devoted to corridors. If the space for these corridors was designed for more versatility, taxpayers would not be so reluctant to see them in their schools. The school planner should learn more about space and how it can be used for more than one purpose; he should examine every square foot of a

proposed school plant for potential versatility, and he should weigh the economic gains of every combination against possible educational losses. Only then can he be sure he is not misusing the quality of versatility.

CONVERTIBILITY OF SPACE

Besides having space which is characterized by its versatility and which may possess the quality of fluidity, we should also have space, as pointed out in Chapter 2, which is convertible. The reader is reminded of the incident in which, because of educational changes, a high school plant in Olympia, Washington, had to go through tremendously expensive space changes. A gymnasium was sliced horizontally to provide shops and drafting rooms on one level and a cafeteria on another level; an auditorium was sliced two or three ways both horizontally and vertically into cubes which were used for classrooms; classrooms were converted into a homemaking suite; and many other physical conversions were made. Unfortunately because these spaces had not been designed for convertibility in the beginning, the changes which were made were not only expensive, but also very unsatisfactory; the results had poor natural lighting, improper natural ventilation, and shapes impossible to use efficiently. Actually the remodeling which was done was ingenious; the school planner who had a hand in these conversions had imagination and a great knowledge of building, but he was tied down from the start. The new building had not been designed for convertibility.

The importance of the convertible quality of space cannot be over-emphasized. School planners should study other building types. (This factor will be expanded later on in this chapter, but it will be treated here from the point of view of convertibility.) If they would study office buildings, for example, they would find that the up-to-date office building has been designed with no definitely set partition arrangement. Of course, much thought has been given to how the partitions can be arranged for many situations, but not for just one. As tenants come and go, the partitions are changed accordingly. The schoolhouse planners can take a lesson from the architects of office buildings.

The importance of convertible space can most readily be seen in the examination of a typical main street store grouping. Look at almost any typical main street. Grocery stores have been converted into jewelry stores; jewelry stores have been converted into shoe shops; shoe shops have been converted into drug stores; and drug stores have been converted into clothing stores. In many cases a 100-foot development will have changed its function at least a dozen times. Compare this with the high school in Oklahoma City, mentioned in Chapter 2, for which there were some 60 changes made in the curriculum, courses added or subtracted, during a 15-year period. When courses are added or taken away, the function of at least some of the space required for teaching courses is changed accordingly.

Now consider the residence, perhaps the reader's own home. There are many, many cases in which the partition which separated the living room and the dining room has been removed to give more space for the living function. Garages have been converted into lounges, nurseries, and bedrooms. When the children grow up and go off to school, bedrooms are sometimes converted into all-purpose rooms. The all-purpose room probably originated in the home in the first place; we school planners simply cribbed the idea.

Because of the continuous advancements towards perfecting the manufacturing process, industrial architecture gives the characteristic of convertibility prime consideration. One of the outstanding advancements which architects of these wonderful buildings have made is the technique that regardless of how the buildings are divided with partitions there is good natural lighting and ample natural ventilation. And, fortunately, many school planners have been influenced by the architectural techniques used in industrial buildings. The Portola Junior High School in El Cerrito, California, with its saw-tooth roof over one of the laboratory wings, designed by John C. Warnecke, is a beautiful example of the close tie between industrial architecture and educational architecture. The space within this wing may be converted into almost anything without great expense or without marring the beauty of the architecture.

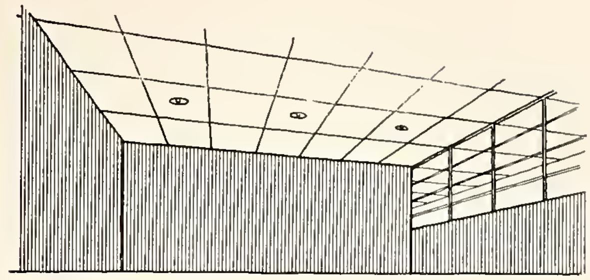
According to Douglas Haskell, school buildings in certain situations, for instance those in residential areas which may become commercial or industrial areas in future years, should be designed so that these schools could be easily converted into stores and apartment houses, etc. This may sound a bit far-fetched to some of the readers, but it makes sense to the writer, who has worked with at least a dozen or so communities which have had old school buildings located in commercial areas or on major industrial highways. Had they been designed for convertibility, these old timers could have been sold for commercial or industrial use at a high premium. But instead they were torn down to the ground to be replaced with new stores or factories.

All building types need convertible space. But it seems that the school building needs it more than any other kind of building. We know today that the educational program is changing, and that it will probably continue to change throughout the years to come. We know also that space which the educating process occupies must change, too. Therefore, school planners must give much careful consideration to the convertibility of space—both enclosed and exterior space.

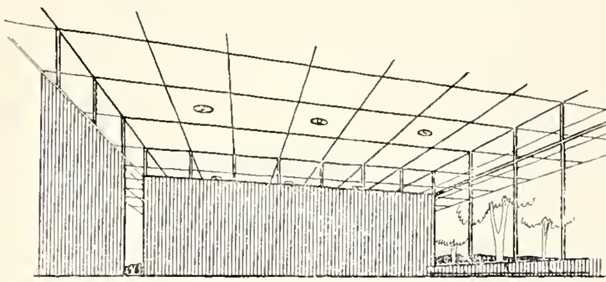
THE EXPANSIBILITY OF SPACE

This brings us to the fourth quality of space, its expansibility. School buildings require changes not only within the envelope, but also in the form of additions

and annexes. A school plant is never finished. Education makes changes continuous. Working drawings and specifications for additions to two elementary schools recently built in Port Arthur, Texas, were being developed at the same time the original building was going up. This same thing has happened many times throughout the country during these school building boom years. Sometimes increased enrollment demands these additions, sometimes curricular changes, but whatever the cause, they are inevitable. School planners must recognize this fact. The school plant must be designed to grow without growing pains; additions can be very expensive if provision has not been made for them. One of the worst evils of the P. W. A. school building era was the inflexible school floor plan so commonly used, with classrooms and laboratories sandwiched by the gymnasium on one side and the auditorium on the other, and with no provision for effective expansion. The preceding period, which produced the square floor plan with corner room classrooms and the auditorium on the top floor, was not much better in this respect. If additions were made, exterior exposure had to be sacrificed in two or more classrooms. These schools simply were not designed for expansibility. We know now that new school building space must have this quality. We know that with but few exceptions new school plants must be planned from the very beginning for continuous growth. Of course it has already been mentioned in Chapter 5 that there have been instances where anticipated neighborhood growth did not materialize, and this possibility should be considered. But whether growth is anticipated or not, it is a good rule to plan for expansion. It pays off in savings to the taxpayer, in efficiency to the changing education process, and in pride and appreciation of a unified, beautiful plant to the pupils who must work and live in these ever growing schools.



139. The feeling of confinement which generally characterizes the typical classroom . . .



can be eliminated by the use of glass to separate the walls and roof planes, which allows the classroom space to penetrate other spaces. This technique recognizes the fluid quality of space.

FLEXIBILITY—FLUIDITY, VERSATILITY, CONVERTIBILITY, EXPANSIBILITY COMBINED

Generally when school planners speak of flexibility of space they are referring to all four qualities of space—fluidity, versatility, convertibility, and expansibility—which have been discussed in these pages, particularly the last three. Flexibility is a good word, but to the skilled architect, who has a well-developed concept of space, the word has much too broad a meaning, and he feels that it should be broken down into the four categories mentioned. But, since it has cropped into our school planning vocabulary as a general term, and since it is always nice to have a general term which means a lot of things, flexibility as used in the following paragraphs will have the inclusive meaning.

We have talked about flexibility at every school planning conference held these last few years; we have made it the most common word in our planning nomenclature, but we still have not been able to put it into practice. It is a difficult job to make a building truly flexible. It takes all of the imagination and skill of composition that a competent architect can muster to make a building flexible to any degree. The restraints put on him by conventional structures, by common building materials, and by precedent of architectural styles, modern as well as traditional, make his job very difficult. Even if he could get over these hurdles, he has public opinion to reckon with. Even if education demands it, will the public accept flexible school plants?

The author has great faith in the public. Generally, out of the fuss and muss of controversial school building issues, the public will rule in favor of the logical and the right. It will not be the public which will hold us back; it will be our own lack of imagination. Rigid thinking has resulted in rigid buildings.

Consider the opinion of Matthew Nowicki, that very skilled architect who came over to this country from Poland to work on the United Nations Building and liked this country so well he made North Carolina his home, but who was killed in an air crash in India while working on plans for the new capital city. This great architect, in one of his unpublished essays, "Remarks on the Origin and Trends in Modern Architecture," has this to say about flexibility: "The recent changes in modern architecture are perhaps as basic as those separating the 1920's from their predecessors. True that we share our vocabulary with this period of yester-

day, but the same words have for us a different and often basically opposite meaning. We also speak of functionalism, but then it meant the *exactitude*, and now it means the *flexibility*. Those are two opposite concepts. In our thoughts priority often is given to the psychological and not the physical human function. The concept of a short lived structure removed with the rapid change of technology is replaced by a notion of architecture that will be our contribution to the life of future generations . . . Form follows function may no longer satisfy ambitions aroused when form becomes judged for its universal values, but sensitivity to the minute exigencies of life remains the source of creative invention leading through the elimination of 'exactitudes' to the more important and more general truth which equals beauty." Although Nowicki was speaking of all architecture when he made this keen analysis, it could not be more fitting if he had aimed his remarks solely at educational architecture.

What do other architects think of flexibility? The following comment by Lawrence B. Perkins should give us good reason to believe that flexibility is to future school plants what formality was to school buildings in the past. His comments concern the high school plant. "We believe that two important trends will emerge in high-school planning. The first is *flexibility*. Spaces will be planned for double and triple use in the crowded years ahead, and for adaptability to changing ideas of curriculum as the maturing concept of the high school's role emerges from the present state of flux."[41] The reader may be interested to know that he lists as the second trend the reversal of the trend to huge, central high school plants serving oversized districts. Perkins looks into the future and sees flexibility. He has never led the author astray yet, and he has been leading him for some time.

Another very famous architect, Henry L. Wright, lists flexibility as one of the four major factors of the school building plan helping to serve education efficiently. He says that a good school building plan will emphasize: "(1) Optimum space allotments for instruction, administration, and auxiliary and community services; (2) Flexibility in structural plan and building materials to permit ready adaptation to the changing content and methodology of education; (3) Comfortable and efficient seeing and hearing conditions; (4) appropriate provisions for heating and ventilation." His authority for listing flexibility as the second major factor is his own long experience in building successful school plants which have grown without growing pains.

Now consider the opinion of another highly skilled architect, one who has crowded much experience into very few years, Wallie E. Scott Jr., of Texas: "A few years ago when my associates and I designed our first school, we made a timid attempt (bold to us then) at flexibility. We designed a non-loadbearing classroom partition which could be easily moved by a good carpenter. Last year we got a bit bolder and designed a demountable partition unit which even the janitor could move with a screw driver. Where do we go from here? If we can muster up still more courage, we may even come up with something that approaches ultimate flexibility. We do not know exactly what it will be, but why could we not produce an architecture where the structure is completely free of walls, with the roof and floor construction containing all heating, plumbing and electrical facilities? Between these two planes could be built space dividers—essentially free-standing low partitions, such as cabinets and chalkboards, that every teacher and student could move, without the screw driver." Scott is fully aware that the biggest problem created by this ultimate flexibility is sound control. He believes, as does the writer, that even now the problems of natural lighting and natural ventilation can be licked, and that it will not be too long before the sound problem can be solved. That is the wonderful thing about educational architecture; we have lots to look forward to. For a forward look refer to Case Study 66, a stimulating scheme by John Lyon Reid.

It is reasonable to expect that we shall in future years see schools based on the open plan which will afford a free flow of space in the general teaching areas. The architects, educational consultants, and school administrators who plan these schools will talk more about fluidity, versatility, convertibility, and expansibility of space and the ways to achieve these desired characteristics of a good school plant, and talk less about concrete block versus plaster partitions. The planners of these flexible schools will be space architects, not room layout draftsmen. They will put new emphasis upon volume instead of mass; they will work with space as their medium; they will think in three dimensional space instead of two. And flexibility will be the keynote of their architecture.

COMPOSITION OF ARCHITECTURAL SPACE

Up to now this chapter has concerned itself with qualities of space. This next discussion will concern the composition of architectural space. A discussion of this kind in a book of this type, of course, will have to be short, but there should be at least enough to show the readers, particularly those who are not architects, that planning school buildings involves more than mere preparation of diagrammatic floor plans. It has been said that space is the medium of the architect. Of course it is a necessity that he know something of the technology of materials and structure which must be used to enclose space, but just as important, and even more so, he must know how to compose space. It is the job of the architect to compose the main elements of space into an efficient and beautiful school plant. It takes a great deal of skill to do this, as every experienced architect knows. The greatness of architects like Wright, Le Corbusier, Neutra, Mies van der Rohe, Saarinen, and Gropius lies in

their abilities and their concept of space compositions. Only through such skills of composition can architects ever hope to produce great masterpieces of functional and beautiful space.

The primary laws of composition are the same whether they apply to painting, sculpture, literature, music, or architecture. Even the terminology is the same. The painter, the sculptor, the writer, the composer, and the architect all talk about rhythm, texture, proportion, form, scale, continuity, accent, color, balance, and unity. Sculpture and architecture in particular are closely related to each other because each has to do with the composition of three dimensional space. But architecture is just as closely related to literature and painting. It is one of the fine arts; in fact someone said it is the "finest of all fine arts." And architecture and music, too, are correlated. Someone else said architecture was "frozen music." The facts show the intrinsic unity of painting, sculpture, literature, music, and architecture. The mutual art is composition.

Most of us have some understanding of the great skills connected with music and the other fine arts, but for some reason we consider the composition of architectural spaces as requiring few skills. And why not? Practically anyone can develop a diagrammatic layout of the main elements of space in a school plant and come out with a certain degree of functional quality. Even the grocery man on the school board (and there is nothing wrong with grocery men; the author's father was one; so was his father; and so was his father!) can do that. But it takes a highly skilled architect to make such a layout and have it be a part of an economical structural scheme. It takes even a better architect to create a functional and economical scheme and also come out with a structure which has good environmental controls, and it takes a still greater one to compose these elements of space into an efficient and economical building which is conditioned to provide the right kind of environment, and which integrates these spaces into a beautiful architectural composition. Yes, it takes plenty of skill to compose architectural space; that is why we are all still students.

So often plans of school plants are judged solely on the layout. Many times the author has been asked to criticize certain preliminary floor plans. It is like judging the depth of the well by the length of the handle on the pump. School administrators and the school board members should understand this. They should remember in reviewing preliminary plans that when the competent architect makes these simple layouts, he is simultaneously thinking of the structural system, the heating and ventilating system, the environmental controls for providing natural lighting and ventilation, the materials of walls, ceiling, and floors, the scale and proportion of the envelope, and last but not least, of space composition. What appears to the layman as only a thick line might mean to the architect a wall of a certain height made of a certain material having a certain color and texture to give a certain spatial effect.

Since the task of integrating all of these into a unified composition is so difficult, the architect should be as free as possible of limitations. He has limitations enough to start with: limited funds, difficult site conditions, adverse climate, required space and equipment, and so on; to give him a layout to work from is simply tying his hands too much. There have been many occasions where school administration and school board members have handed layouts to the architects and said, "Make the building this way." A planning process of this kind does not make sense. From the standpoint of composition it is like saying to a composer, "Here produce me a symphony, but use only these few notes," or to a writer, "Write me a story, but use words found only in the second half of my dictionary." From the professional point of view, it is like a layman's going to a doctor and saying, "Operate on me this way." The architect must have a free hand to develop layouts, because these simple layouts, more than any other factor, dictate the composition.

The architect, like the composer, must give simultaneous considerations to many factors, but these seem to have major importance: (1) beauty, (2) site, (3) environment, (4) structure. They will be discussed in this order.

THE CONSIDERATION OF BEAUTY IN ARCHITECTURAL COMPOSITION

The idea of beauty as a necessary part of architectural composition is nothing new. Vitruvius over 2,000 years ago said it for all of us, "Architecture is Utility, Beauty, and Strength." The verb is an equality sign, the subject is universal, and the whole statement represents an ideal approach by all great architects of today and yesterday. Their structures combine utility, beauty, and strength—each dependent on the other two.

But the question is repeatedly asked, "Can a functional school building be beautiful?" And there is only one answer to that question.[42] If a school building is truly functional, it is, as a part of its function, beautiful. Maybe it is better to use the reverse. If it is not beautiful, it is not truly functional. We, as school planners, must have a broad and full understanding of function. We still must remember and profit by the lesson that buildings must be efficient in meeting the physical needs of their occupants. But we have added to that lesson the knowledge that emotional needs are just as real and just as important as physical needs, and have realized that these, too, must be served.

This has been said before, but it should be said again: A school building, as we know, can be a highly efficient machine designed to facilitate the curriculum; it can have all of the environmental controls necessary to give the children the right kind and right amount of natural light and natural ventilation, together with

proper heating and mechanical ventilation and adequate artificial lighting; and it can be constructed economically with full use of the technology of the day. It can be perfect in every way by these criteria. But if the children move in and find that the building and surroundings do not "feel good" to them, then the building is not truly functional. The emotional needs of the children have not been served. Those needs are even more real to the pupil than the need for proper lighting. If the building does not fulfill the emotional needs, how can it be functional?

Not too long ago at a graduation exercise in Stillwater, Oklahoma, the writer had the opportunity of hearing one of the high school graduating seniors say this: "The school building should not only be thought of as a place of learning . . . but also as a place where the student can find relaxation and enjoyment, and a place of which he can be proud." That is one of the most profound statements which will find a place in this book. First it is important because it comes from the source of our discussion—the pupil. And second, this pupil has pointed out the most overlooked phase of school planning.

Antony Part, of England, who has been mentioned earlier, is aware of the pupil's second point.[43] After seeing American schools for the first time, he was concerned about the atmosphere of these schools. He points out how utility and simplicity in most cases have been divorced from dignity, and he raises the question, "Is the monument to be succeeded by the hencoop?" It is his belief, and most of us will agree, that it takes greater skill to compose a modern school than to produce a traditional one. Architects like Lawrence Anderson and John Lyon Reid, according to Part, (and the author most heartily agrees, since both were his professors at M. I. T. and will continue to be his professors to whom he can turn for advice) possess such skills and their school buildings show it. But in general the architects of the nation are far behind. As soon as we look up from concentrating on the foot-candle and start concentrating on the pupil, too, our school plants will begin to meet the emotional needs of youth. The pupil will have that place he can relax in and enjoy, that place which will make him proud. But it is going to take newly developed skills on the part of the architect to make these school plants beautiful. (For that matter it is going to take much patience by the school administrator and school board to let him do it.) As architects we must find ways to make our schools more appealing to the children and teachers who must occupy them. We must find means to get us out of the predicament which Antony Part said we were in when he made this comment: "I think the modern approach is . . . that the buildings are designed 'from the inside out.' The only complaint which laymen have about this style is that many of the buildings look as though the architect had never reached the outside." That statement hurts, but it is the truth. And the trouble lies in our skills of architectural composition.

One glaring compositional fault, and it ties in with what Part said, is that the typical schoolhouse has very little unity. And unity is an essential part in any kind of composition, architectural or otherwise. From the standpoint of beauty a pleasing composition must be designed as one integrated, harmonious whole. Certainly this unity cannot be achieved when the architect takes one idea or part from one building, another part from another building, another part from still

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THE ARCHITECT AS AN ARTIST

"The architect is as much an artist as the painter, sculptor, composer, or writer. Each artist has a different medium of expression and the architect has one which is hard to visualize. His artistic endeavor is concerned primarily with space. He molds space as the sculptor molds clay. He defines space as a painter defines an area of his canvas. He modulates space as the composer creates his rhythm, and he articulates space as the writer through articulation creates a design of thoughts.

Let me say now that this artistic quality the architect must possess is not totally an acquired intellectual ability. As with other artists, the architect's ability to express what he feels makes him an artist.

The design of space cannot be achieved by formulae. However, there are elements in spatial design that we can give names and make some definite statements about. Men have devised rules for dealing with some of these elements, but as with any rules applied to art, they are broken as many times as they are followed. Man does not experience emotion by a set of rules.

One element of spatial design is called proportion. Basically, proportion deals with the visual relationship of one thing to another. For example, space to space, solid to solid, or space to solid. To learn of good proportion you must observe situations and try to analyze your own and others' reactions to the relationship under observation. In some extreme cases your teachers can give you examples to examine, but generally it is a process of look, feel, analyze and learn.

Another element, often confused with

another building, and so on, and tries to combine them into a proposed building. There is nothing more disturbing than a collection of misplaced cliches. The greatness of architects like Wright and Corbusier is that in their buildings every detail is conceived as an integral part of a greater single whole, polished as a little composition in itself, and then blended into the oneness of the building. To them a door or a window is a passage in a symphony. And here lies the secret of architectural beauty. As school architects we should take note.

The author is going to stick his professional neck out farther and talk about proportion and scale; the discussion will be too elementary to be of much use to his architect readers, but this book is for all school planners. Proportion, as we all know, is expressed in mathematics by such symbols as a/b equals c/d. This relationship of parts is not so easily expressed in architecture. Architecture is more closely related to music and painting. We find pleasure in music through the relationships of notes, and in painting through the relation of color, if these elements satisfy our sense of proportion. In architecture it is the relationships of elements of space, and the planes, voids, and solids which form these space elements, which gives us pleasure. The sense of proportion is an artistic sense. That is why the architect must, among other things, be an artist. Proportions are delicate in the human figure; among the millions of heads no two are exactly alike, yet all in some respect are similar, and a half-inch on the end of the nose may constitute a deformity. Proportions in architecture are just as delicate. The best architects are the ones most sensitive to proportions.

A beautiful architectural composition in which unity is obtained through an order among elements combined in such a way as to preserve good proportion throughout and in which all the parts are in scale. That brings us to the question, what is scale? As a bare definition, we can do with the statement that scale is appropriate size. A door, for example, must be of a certain minimum height, and so must steps. And doors and steps, more than do any other items, help determine the scale of buildings, at least of buildings to be occupied by humans. Large hanger doors are a clear indication that those buildings are for large machines, not for humans; the great steps of the Parthenon clearly indicate that that building was designed to house a god.

Scale, as applied to school architecture, then, means that doors, steps, drinking fountains, furniture, etc., should all be of a size appropriate to the physical dimensions of the occupants, most of whom are children. But "appropriate size" means more than that. It means that size to be appropriate must be conducive to emotional as well as physical comfort. If, for instance, a 12-foot ceiling in a classroom "feels" too high to the children, or if an entrance is so grand it intimidates the children, these are not of "appropriate size"; they are out of scale. Thus, scale is a basic factor of humanism in architecture.

Scale and proportions are so closely related, we cannot study one without considering the other. First we should clearly distinguish the two. Consider the human figure again. If a man has abnormally large hands, these parts are out of proportion. If he is only three feet high and all of his parts are in proportion, he is out of scale. So it is with buildings. There is a little house not far from where the writer lives that has the proportions of the large colonial mansions of the South, equipped

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proportion, is called scale. Scale can best be defined as the relation between man and his spatial environment. A room with 6′-0″ ceiling for a man 6′-2″ is obviously out of scale. An excellent example of the use of scale is found in many old cathedrals. In these structures, through tremendous heights, the architect created a relationship of environment to man such that man would feel his smallness as related to God or the universe.

There are many other design elements affecting space which we will discuss in future lectures. However, one of these, unity, should be discussed each time. Unity simply means oneness. Without unity architecture does not achieve its goal. As applied to a building we must feel that every small piece of that building belongs exactly where it is. As with the painter who, by the omission of a line or a spot of color, may have an incomplete picture, so it is in architecture. The oneness of the building should be such that to remove a small piece would make the design worthless. As with the other elements we have discussed, unity must be partially judged by your ability to feel if it is right or wrong.

Many people can put oil on canvas—but they are not artists. Also, many people can build a good shelter, but they are not architects, because their shelter lacks the qualities needed to make it pleasant to the senses. Many people can appreciate beauty as they experience it, but you will be the ones who must create it for them."

From a series of lectures to freshmen architectural students, 1949-50, by Prof. G. K. Vetter.

with columns and all. But instead of being 40 ft. high, the columns are only 10 ft. high, and the effect of standing on the porch is the same as that of standing before a doll house. The grandeur of Colonial cannot be retained if the scale is reduced. There is a school not far from this same house which is an example of shrunken Georgian. It is a one-story building with two-story proportions. The windows are out of scale; a shrub beside them looks like a tree. At its best this school is a miniature copy of the real thing, because the architect simply did not have a concept of scale. Parts of buildings may be out of scale, yet still be within reasonable dimensions as far as man is concerned. That is why scale is so hard to define. Materials, too, have their scale effects. A small wall with large stones may not have proper scale effect; a large wall with small masonry joints may have an awkward scale effect. Scale, therefore, concerns the requirements of human needs, with the requirement of building materials, and requirement of natural relative proportion.

Unity, proportion, scale—these are only a few of many considerations of architectural composition. Nothing has been said, beyond a mere mention, about rhythm, texture, form, continuity, accent, color, and balance. Architectural rhythm expressed by successive solids and voids, the contrast in texture of glass against stone, the variety of forms created by new structural techniques, the continuity of architectural lines, the accent of the composition by an inviting entrance, articulated color, the need for balance—these too are important factors which go to make architecture out of mere shelter. We cannot expect the school administrator, the educational consultant, or members of the school board to know all of these things. But we can expect the architect to know them; he has been trained as an architectural composer. He speaks the language of space. He uses it as his medium. He makes the difference between just another building and a beautiful building. These comments about the art of composition, one of the architects' main skills, are much too incomplete, but it is hoped that there is enough here to give those school planners who are not architects some appreciation of the well-composed, beautiful school plant.

THE CONSIDERATION OF THE SITE IN ARCHITECTURAL COMPOSITION

Another element which definitely will have great bearing on the final composition of spaces within the school plant is the site itself. Its size and shape influence the space arrangements as much as anything, particularly when the site is small. Architect John C. Warnecke's Mira Vista Elementary School in El Cerrito, California, often referred to as the "contour school," is one which has been composed "to create a functional, single-story open plan whose lines and materials and tones would tie the structure into the setting, giving it an appearance of growing out of and being molded from the hill." (Refer to Case Study 55.) His Portola Junior High School, designed for the same school district, also was composed around the lay and shape of the land. The layout of this school follows "the actual contours of the ground as they sweep backwards to each side of the hill." (Refer to Case Study 48.) These are only two examples of thousands of schools shaped by the site. For other Case Studies relating to sites refer to 1, 3, 21, 27, 46, 49, 51, 83. Of course, when we get right down to it, how can any architect design a school without first examining the site? How can he locate entrances without knowing where both vehicular and pupil traffic lines flow into the school plant? How can he orient the spaces without knowing exactly where the morning sun comes up, and from what direction the prevailing cool spring and fall breezes blow, as well as the cold wintry winds? How can he compose a building layout without knowing the exact location of utility lines, streams and rocks, and major trees? That is why the A. I. A. contract agreement between the Owner and the Architect includes the furnishing by the owner of a complete survey which designates the location of all of these things. Many an architect, the writer for one, has been caught short by not having these surveys before layout planning was begun.

Not long ago, in western Oklahoma, a school board insisted that the writer and his architectural associates start preliminary plans before the site survey was completed. It was the same old story: "We must get this building ready for these kids by next September." The architects did the next best thing, which incidentally proved a very poor substitute: they "eye-balled" (as the boys in the drafting room would say) the slope of the land. Preliminary plans had been approved and the architects were in the middle of working drawings and specifications before the site survey was finally completed and given to the architects. It was found that their guess of the slope of the land was way off—enough to produce a number of red faces and considerable extra cost to the school board. In fact, if the architects had received the site survey at the beginning, the building layout would have been exactly reversed. The site, as much as any other factor, dictates the layout of the spaces within the school plant.

THE CONSIDERATION OF ENVIRONMENTAL FACTORS OF ARCHITECTURAL COMPOSITION

Chapter 3 describes, in some detail, how factors of environment help to shape building form. There is not much more that can be added here except to emphasize the fact that architectural composition must include environmental controls. In fact, sometimes they have major effects on the total composition. Not long ago the writer had the opportunity to serve on the jury of a

national architectural competition, involving over 100 schoolhouse entries. The amazing thing about this group of schoolhouses was the apparent common force which influenced their geometry. In this case it was natural lighting. With but few exceptions the character of each building was governed by this lighting force. The ways of solving the natural lighting problem were too conspicuous. The solutions were not organic, only applied cliches. Environmental controls must be integral parts of the composition.

Which is more important—form created for beauty or form created for comfort? They are both important. To choose between them is like saying which is the more important, the base clef or the treble. What a terrible limitation it would be for school architecture if environment required that all classrooms have sloping ceilings! Yet some architects put so much emphasis on one technique of environmental controls, that they limit themselves in the same way. If Chapter 3 does nothing else, it has been worth its type if it convinces the reader that there are many, many ways of solving problems of lighting, heating, ventilation, and sound control. If architects have all of these many ways at their disposal, they have greater freedom to compose space. That is why architects should know the technology of environmental controls; the broader their knowledge, the greater their range of composition.

THE CONSIDERATION OF THE STRUCTURE IN ARCHITECTURAL COMPOSITION

The difference between architecture today and architecture fifty years ago is in the structure as much as anything else. In older schoolhouses the emphasis was on making the load bearing walls look even more heavy by deep-set windows and doors. Today the emphasis because of the skeleton construction, is on making the walls and partitions appear as screens. The traditional wall pierced with windows and doors is not often seen in new schoolhouses. Because of skeleton construction, architects can now explore the possibilities of fluid space. They are now more concerned with volume than with mass. Where in the past architects made use of ornament for certain accents, interest, and variety, they now make use of the structure itself. Open web joists, trusses, and beams are often left exposed for interest (and we must admit, for economic reasons, too) with one or two singled out of a group and painted a bright color for accent. The results are surprisingly pleasing. The columns, too, are left exposed, wholly or partially, and accented by color for contrast and rhythmic effect. The esthetic possibilities of the column and screen principle are unlimited. Already Mies van der Rohe has perfected an architecture by giving emphasis to structural beauty. Some of his buildings at the Illinois Institute of Technology have an intrinsic structural unity like that of a Mondrian painting. This means that the structure itself may be an artistic component in the composition.

The obvious fact, of course, is that the composition of the main elements of space cannot possibly be made without thinking of how the roof can span over the spaces. There is good reason to believe that the old time classroom was 24 ft. wide simply because that was the maximum length of a stick of structural lumber. If so, the structure certainly controlled the composition, at least of the classroom wing. And it does to a certain extent today. But just as we have found many ways to achieve adequate environmental controls, we have found many ways to span the various spaces required for teaching. The desire for flexibility has led to larger spans for classrooms.

Architect Eberle M. Smith lists two trends which apply to the structure and the general architectural composition of space. He says, "There seems to be a uniform trend toward one-story construction. This is especially true at the elementary school level and has also influenced the secondary school design."* And he notes "the continuing movement towards skeleton construction. This structural arrangement allows for complete freedom and flexibility in locating interior partitions and arrangement of rooms. It allows the designer complete freedom in the exterior envelope of the building. He may use strip windows accompanied with panel type curtain walls as well as masonry walls. Framing, itself, may take the form of transverse bents or beams. The transverse framing enables the designer to use many types of cross sections and arrangements of roof lighting and roof venting. The longitudinal system of beams with transverse purlins or joists can also be arranged to provide any type of cross section. The so-called umbrella type of construction comes under this heading. This type of structure is generally used in connection with a more or less flat roof, which covers quite a large area, may be simple in design and construction, and should result in maximum economy. By concentration of a large floor area in one rectangle, this umbrella type eliminates much of the principle cost of the structure. Usually, in this type of construction, supplementary lighting is introduced into rooms by means of skylighting or roof lighting."

In addition to keeping out the rain, wind, snow, cold, heat, and enveloping the educating process, the structure must resist vertical loads such as snow, in certain areas, and the weight of its own building materials, equipment, and the people who use it. It must resist horizontal loads such as windpressures caused by hurricanes and tornadoes, and ground forces caused by earthquakes. Most of us are familiar with these functions of the structure. We can now add to them the esthetic function and the function of allowing the free flow of space.

*by letter.

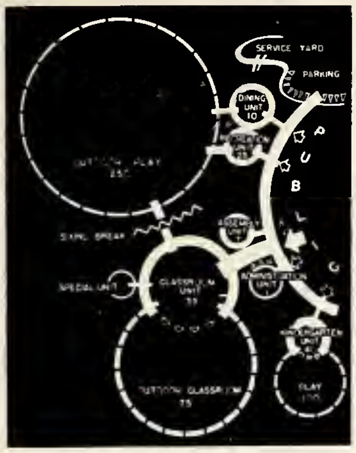
THE MAIN DIVISIONS OF SPACE

The brief discussion on the concept of space at the beginning of this chapter was inserted to help the reader see that a cubicle, like the conventional principal's office, is one solution to a space problem, but not the only one. If he accepts this, the reader will find it easy to recognize that the large space within the envelope does not necessarily have to be divided everywhere by solid walls from floor to ceiling. (Maybe a simple free-standing, movable screen would do the job just as well, or a sheet of glass, depending on whether the space division problem had to do with sight or sound.) He should be able to grasp the significance and possibilities of the open plan which is now being used in the home, but which could very well be adapted to some areas of the school plant. It is hoped that he will comprehend the full meaning of flexibility, and will be aware that it means more than just a sliding partition or movable cabinets. And then last, it is hoped that throughout this next discussion, which has to do with the composition of the main elements of space, the reader will remember all of these things, plus the fact that in the general composition of a schoolhouse, consideration must be given simultaneously to the beauty of the environment, to the site, and to the structural system, as well as to educational function.

The complexity of dividing space on the school site and within the proposed building can be seen right away in a mere listing of the kinds of space needed. But the list should be read with a clear realization that the architectural problem is not only to provide these spaces, but to separate them, one kind from another, according to some harmonious pattern. These are the major spaces that must be so divided:

1. *Academic Studies.* This is quiet classroom space for the self-contained classrooms of the elementary level and for subjects like English, mathematics, social studies, and languages of the secondary level.
2. *Specialized Studies.* These are different kinds of spaces, some noisy, some quiet, some outside. They all pose special problems and require special equipment. The spaces are for such subjects as homemaking, science, shop, agriculture, and music.
3. *Physical Education.* This includes both an inside space for play and exercise, and an integrated outside play area, besides, in some cases, football stadiums and other facilities for team sports. It may include a health unit.
4. *Assembly.* This includes space for group meetings having special requirements of seating, seeing, and hearing.
5. *Dining.* This is a noisy space if large groups are to eat at once. Sometimes it can be satisfactorily combined with other kinds of spaces. Generally, in connection with dining areas, there are related cooking areas; however, there are successful arrangements where complete separation has been achieved.
6. *Outdoor Study.* This use for space is something new and growing, particularly in the elementary schools, but very adaptable to the secondary schools. Many things besides nature study are taught outdoors in new schools which have joined outdoor and indoor teaching space.
7. *Recreation and Social Activities.* In part, this is included in some of the spaces already mentioned, but it also includes exhibit areas, social lounges, small meeting rooms, back-stage facilities, and places for all sorts of after-school activities such as Scout work and P. T. A.
8. *Administration.* This space, of course, includes the administration suite, and although almost always ignored, but very desirable, a teachers' lounge for use of both men and women. Sometimes it has been found that teaching service centers and health examination rooms located within this area promote administrative efficiency.
9. *Plant Cleaning and Maintenance.* This includes a great variety of spaces in a number of places throughout the school plant. Their requirements are less exacting than some, but they should not, therefore, be slighted.
10. *Vehicular Traffic.* This kind of space is becoming increasingly important as school buses, private cars, motor scooters, and bicycles are increasing in number around the school plant. Parking areas particularly have increased in importance, not only for football and dance crowds, but for daily use, in many high schools, for both faculty and students.
11. *Pupil Traffic.* This space is usually considered under the heading of corridors and outdoor walks, but should include all space necessary for the flow of students in and around all areas of the school plant.

It should be a great deal more obvious than it appears to be that there is no perfect arrangement of space. A plan printed in a magazine to illustrate an excellent solution to one school building problem might not answer another building problem at all, and cannot answer any other problem as well as it did the one it set out to solve. No two school building problems are identical; each is a composite of a number of individual, highly localized factors, each having its conditioning effect on space division. One way to realize the complexity of this problem is to consider the eleven major space divisions mentioned above as comparable to the eight major notes on a musical scale. Everyone knows the unlimited, effective combinations that only eight



SPACE RELATION CHART

	SHOULD HAVE A PUBLIC ENTRANCE	SHOULD HAVE OUTSIDE EXITS	SHOULD BE NEAR A PARKING LOT	SHOULD BE CONNECTED TO OTHER ELEMENTS BY INDOOR OR OUTDOOR CORRIDORS	SHOULD HAVE A SERVICE ENTRANCE	SHOULD HAVE PREFERENCE TO THE BEST EXPOSURE	SHOULD BE IN A QUIET ZONE	SHOULD BE IN A MODERATELY QUIET ZONE	SHOULD BE IN A NOISY ZONE	SHOULD HAVE DIRECT ACCESS TO THE MAIN PLAYGROUND	SHOULD BE LOCATED WHERE IT CAN BE EASILY RECOGNIZED BY VISITORS	SHOULD BE AN ISOLATED UNIT
CLASSROOM UNIT		●		●		●	●					
ADMINISTRATION UNIT	●		●	●				●			●	
RECREATION UNIT	●	●	●	●					●	●	●	
ASSEMBLY UNIT	●	●	●	●	●			●			●	
DINING UNIT		●		●	●				●	●	●	
KINDERGARTEN UNIT		●				●	●	●				●
SPECIAL UNITS				●	●	●	●					

140. Here is a chart which shows space relation within the elementary school. Generally, it is better to study spaces through the use of a chart like this than through analysis of floor plans. A floor plan represents only one solution, and ties itself down to one site, one kind of orientation, one kind of terrain, and one climatic region. That is why this book contains no complete floor plans but does contain such space relation charts as this one.

notes will produce. There are just as many effective combinations in architectural composition, and just as in music there are certain limitations relating to harmonic combinations, so in architecture there are certain harmonious combinations which must be adhered to. Let us look at some of them.

THE SPACE RELATIONS OF AN ELEMENTARY SCHOOL

Consider the space relations of an elementary school. Since children of this level spend most of their time in the classroom-teaching space, such areas should then have choice position to take advantage of the sun, breeze, view, and accessibility. This teaching area should be zoned in the school plant layout, just as is a residential area in a city plan, for quiet living activity. The accompanying Space Relation Chart shows these relations. Note that the classroom units have outside exits. This is necessary, particularly in situations where outdoor classrooms are used and where recess activities are not scheduled. The numbers in each area indicate the number of square feet needed for each student. Special classrooms for library, nature study, music, art, typing, and other learning activities should have similar consideration. The recreational unit, the assembly unit, and the dining unit need not be adjacent to the classroom unit, but the pupils should have the advantage of corridors, either enclosed or open, so that they can proceed to these supplementary, but essential, elements with a certain degree of protection from rain, wind, and sun.

The administration unit should be situated so that visitors or parents coming to the school for the first time will have no trouble in locating it and will not have to go through the instruction area. There is some disagreement as to whether the administration unit should be strategically located in the main line of pupil traffic for reasons of control. A few years ago the writer thought that this was necessary, but now it seems that the principal's job is not to control the flow of students like a traffic cop; his job is to administer to the teachers. If this is true, the location of his office is for the teachers' convenience. That is important, but it is not nearly so important as if the students were involved. The administration unit should be near parking areas for obvious reasons, the main reason being the convenience of the teachers (now they get their break).

The kindergarten generally is pretty much a self-contained unit and has no special relationship with the other space elements, except perhaps the administration unit. It is important that the kindergarten have easy public access, preferably a private drive, so that the large majority of parents who bring their little tots to school may discharge them to the care of the kindergarten teacher conveniently and safely. Note that the space required for a kindergarten pupil is somewhat larger than that required by the regular pupil (40 sq. ft. to 35 sq. ft.), but it is not twice as large! It seems to the author that most kindergartens constructed these days are excessively large. And the prevailing thought among school superintendents, to the effect that as the grades increase the space requirements decrease, does not seem reasonable either, because (1) the activity concept should follow all the way through, from kindergarten to grade 14; and (2) the larger the pupils are, the more space they need.

The recreation unit, the assembly unit, and the dining unit (all relatively noisy) should be located beyond earshot of the classrooms, or else provided with certain sound breaks to hinder the sound from disturbing the teachers and pupils working in the classroom area. Because these units are often used in the evening by

adults, they should be accessible to the public and be located near parking lots. Of course, the dining area and kitchen should be located for efficient service.

Size also affects the space relationships of an elementary school. The trend seems to be toward smaller schools. The small primary school, housing only a few units of grades one through three, is finding good reception in most of the communities where it has been tried, and particularly in Allentown, Pennsylvania, and Oklahoma City. Of course, if an elementary has too small an enrollment, it cannot support such special facilities as recreational units, assembly units, dining units, and the like. We are told that in order to obtain teaching efficiency and administrative economy, an elementary school should have at least six teachers. Therefore, if each teacher has 25 to 30 pupils, the minimum elementary school, housing grades one through six, would have from 150 to 180 enrolled. That is very fine if we can afford it, but by most standards a desirable situation would have about twice that many pupils, 300 to 360, or about 12 to 18 classroom units. Anything over that borders on institutional living, something that we have been trying to get away from in our elementary schools for a long time.

Above all things the final composition of these main elements of space of the elementary school should exemplify a friendly, even homelike atmosphere. Maybe that is the best argument for one-story schools. As architects, we should remember this: when we are at a drafting board seeking a workable and beautiful composition, our job is not to impress the school board members or their administrator, or the editors of our professional journals. Our job is to impress the pupils.

THE SPACE ELEMENTS OF A SECONDARY SCHOOL

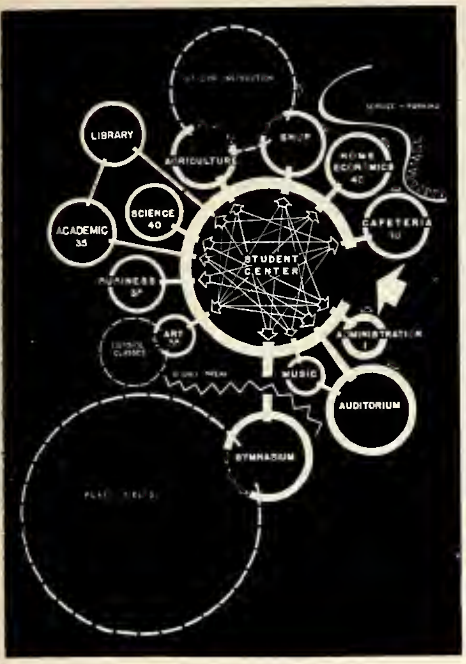
Now consider the space relations of a junior high or high school. Chapter 2 explained that the educating process of the secondary school is the same as the elementary school except that it is a bit more complex. The same is true of the secondary school plant. There are more elements to work into the composition, and each demands more attention by the school planner, except possibly the self-contained classroom unit. For some strange reason this similarity is not reflected in most high school and junior high school buildings today. School planners someplace along the line have got the idea that the high school building must be imposing. Whom are they impressing? Certainly not the pupils. The pupil of this age level wants and has the right to expect buildings just as beautiful and friendly as those now found at the elementary level. Education has continuity from one grade to another. There is no big jump from the elementary school to the junior high, or from the junior high to the high school—or at least there should not be so far as education goes. There certainly should be no great difference as far as architecture goes. Education has replaced formality with informality through the grades—even in Mr. Ludgren's high school science class. Architecture, too, should replace formality with informality, and do it at the secondary level as well as at the elementary level.

As it has already been pointed out in Chapter 2, the uniqueness of the secondary program is in the social aspect of pupil development. This should be reflected in the school plant. There should be places where the pupils may gather to discuss their everyday living problems, whether they be about school work or about home life. There should be facilities in classrooms and laboratories for small group discussions so that the pupils will not only learn skills, but will also learn why they are necessary, and how they can be applied to everyday living. There should be desirable areas, both enclosed and outside, where students can go to relax, study, or simply talk over their problems with fellow students during off-hours.

Now look at the Space Relation Chart for the secondary school. It is very similar to the other one which concerns the elementary school, except that the diagram shows the various elements of space grouped around a so-called student center. This is not necessarily a physical grouping. The student center could be a separated room like the new student lounge in the Evanston Township High School in Evanston, Illinois, but it might possibly be a treatment of the school's main concourse as was mentioned in the Norman High School discussion, or an outdoor terrace like the one at the Portola Junior High School in El Cerrito, California, (see photo 50) or it might be simply a milling area adjoining the entrance lobby as in the Clara Bryant Junior High School (see photo 51) in Dearborn, Michigan. There are many other ways by which the architecture can help with social development of the secondary school pupil.

The administration unit of the secondary school is not very different from that of the elementary school. Perhaps it is used more by the students, particularly if it includes counsel rooms, but it does not necessarily have to be centrally located as far as the student is concerned. It should be on the ground floor for easy public access, and should be near the main entrance. Sometimes it has been found desirable to have the administration unit in close relationship with the business education rooms.

The assembly unit should be on the ground level if possible, for safety and convenience of both student body and community crowds. It should be located for easy accessibility by both groups, and be situated near a parking lot. It should be zoned either by isolation or by proper sound barrier for reduced sound interference with the quiet classrooms-laboratory areas. The stage should have accessibility to such related units as music, speech, dramatics, and stage crafts, and sometimes the dining unit. It is desirable that it be zoned for separate



SPACE RELATION CHART

	Should have a public entrance	Should have outside exits	Should be near a parking lot	Should be connected to other elements by indoor or outdoor corridors	Should have a service entrance	Should have preference to the best exposure	Should be in a quiet zone	Should be in a moderately quiet zone	Should be in a noisy zone	Should have direct access to the main playground	Should be located where it can be easily recognized by visitors	Should be an isolated unit
ADMINISTRATION UNIT	●		●	●				●			●	
ASSEMBLY UNIT	●	●	●	●	●				●		●	
PHYSICAL EDUCATION UNIT	●	●	●	●					●	●	●	
MUSIC UNIT		●		●					●			
ART UNIT				●		●	●					
BUSINESS UNIT				●		●	●					
SCIENCE UNIT				●		●	●					
HOME ECONOMICS UNIT				●		●		●				
AGRICULTURE UNIT		●			●				●			●
SHOP		●			●				●			●
DINING UNIT	●	●	●	●	●			●		●	●	
STUDENT CENTER	●	●	●	●								
ACADEMIC UNITS				●		●	●					
LIBRARY	●	●		●		●	●					

141. This space relation chart concerns the secondary school. The high school is very similar to the elementary school, except that it is considerably more complex; thus the chart is a bit more complex since it concerns more specialized areas. Note, however, that the heart of the school is the student center, an area to help facilitate the enrichment of the curriculum. Such a student center might be in the main concourse of the school and provide for lounges and exhibit areas. It also might serve as a living room for the community.

heating and ventilation.

The preferred location of the library in the composition of the main elements of space is in the center of things, particularly if it is to be used as a real reference center. Today academic subjects such as English, languages, and social studies include many library reference projects, and it is desirable that these spaces be near the library; however, in the future, it is believed that other courses, even the shop courses, will find the library a handy supplement to the teaching program. If the library is to be used by the community, as in Case Study 11, it too should have a public entrance near a parking lot.

The physical education unit should be fairly isolated from the rest of the main elements of space because it is one of the noisiest units of the school plant. It needs to be near a large parking lot to take care of basketball crowds, and, of course, it should have an easy access for the public. Like the assembly unit, it should be zoned for separate heating and ventilation, so that when it is used by the public when school is not in session, only this portion of the school plant need be heated or ventilated. And of course the physical education unit should include or be adjacent to large playing fields for the convenience of the pupil as well as the teacher.

One of the more difficult problems of the dining unit, if it includes a kitchen, is the problem of keeping the lines of vehicular traffic needed for service from crossing pupil traffic lines. The dining unit, of course, should be accessible preferably by corridors, enclosed or open, for the students; but, since this unit is used quite often by the public, it is also desirable to have direct public access from the street and from a parking lot. In some situations, because of public use, it is desirable to have the dining unit located in close relationship with the auditorium. Since the problem of eating in schools is becoming more acute, this will be discussed in considerable detail later in this chapter.

The location of the music unit also presents many problems. Unless they are virtually sound-proof rooms, the spaces within the unit must be isolated as far as sound goes. Certainly the choral group and the band should be separated. Practice rooms, too, should be provided with sound barriers. The band and orchestra room has a definite relation with the stage of the auditorium, and sometimes the gymnasium as well, and in a great many cases school planners allow for this by grouping all three of these together. In some school districts where the band and orchestra work is carried on all summer, it is, of course, desirable to have separate entrances, since almost always the rest of the building area will usually be closed during vacations.

The location of the homemaking unit is still a debatable issue. Some seem to prefer to locate the unit near the cafeteria, since the required food supplies may be purchased by and delivered to the person in charge of the school lunch department. In some schools this person is also in charge of the homemaking unit, but in other school situations the two programs are completely independent. Before the architect makes a final decision as to the exact position of the homemaking unit he should tie down such variables.

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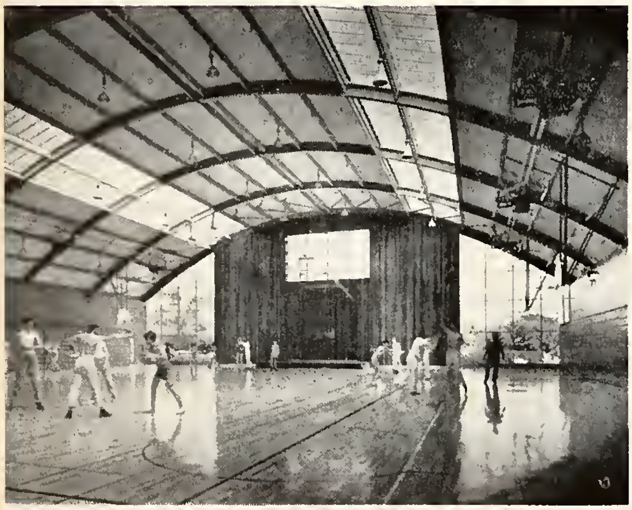
Outdoor Play Areas

142-146. There are some days in the year when only an umbrella-like structure is needed to carry out educational and recreational activities. Here are a few examples of protected activity areas which serve the pupils most effectively and are economical as well. These outdoor shelters are designed to protect groups from the hot sun, rain, mud, and cold winters. One solution to the protected area problem could be a porch-like structure as shown in the first photograph (142). Another could be an enlarged connecting corridor between two wings as shown in the next photograph (143); a free-standing structure as shown in photograph (144); a scheme which

Indoor Play Areas

147-151. Most games and physical education activities can better be played outdoors, but there are some days of the year when, because of the rain, wind, or snow, completely enclosed shelter is necessary. Because of this, we have our so-called gymnasium. Here are examples of gymnasiums which exemplify the many types of structural techniques used for covering these large areas. Take a look at the first photograph (147). This school by architect John L. Reid is a fresh solution to the difficult lighting and ventilation problem. The second photograph (148) shows another solution to the lighting problem; it, too, makes use of top lighting, but in a much different way. The middle photograph (149) makes use of directional glass blocks installed in high ribbon bands near the ceiling. The next photograph (150) is a low-cost shell designed for Maine's climate.



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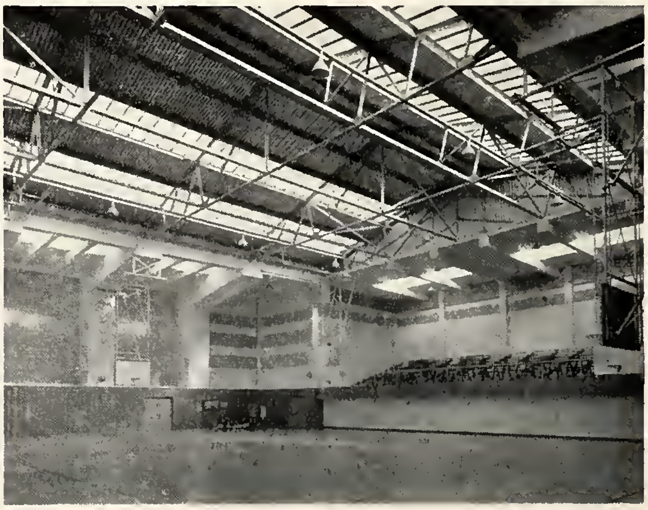

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simply involves the extension of the classroom roof (145); or a scheme like 146, with the play area adjacent to a large all-purpose room equipped with sliding doors, which can make both indoor and outdoor space into an integrated and unified expansive area. Such umbrellas as these make good sense to the teachers and pupils who use them. The principal of one of these schools said that he would rather give up a couple of classrooms than his protected playshed, which he used for everything from teaching classes to having assemblies.

The structure consists of laminated wood arches, which have the distinct advantage of providing for all the enclosed space to be used for games. This is not true of trusses, which must limit the planning space to their bottom cord. This shape of gymnasium is particularly adapted to such games as badminton, tennis, volleyball, and basketball. The last photograph (151) is a Perkins and Will creation. Such a solution provides a play area as pleasant as the outdoors, and a far cry from the dark, dank conventional gymnasium. The day may not be too far off when plastic domes are used to cover play areas and to modify the weather just enough to simulate mild outdoor conditions.

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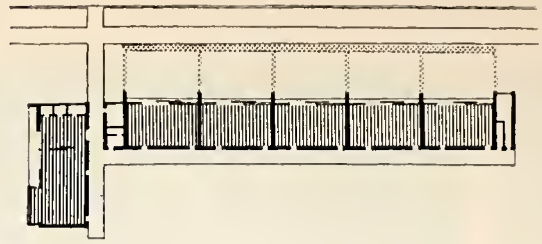
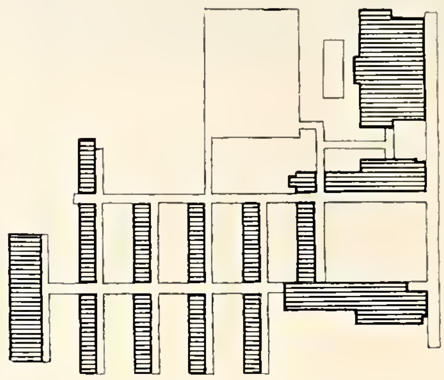
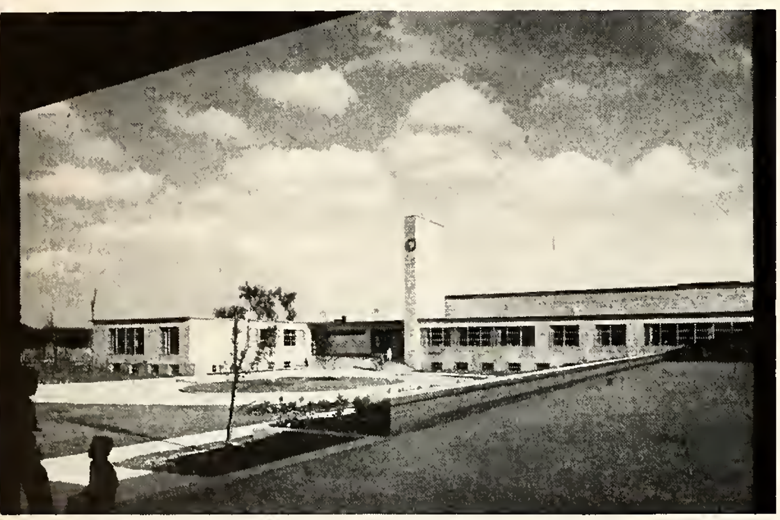
152 1936



153 1939





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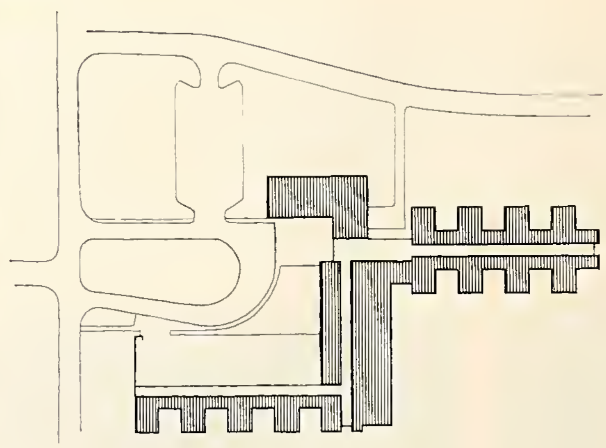
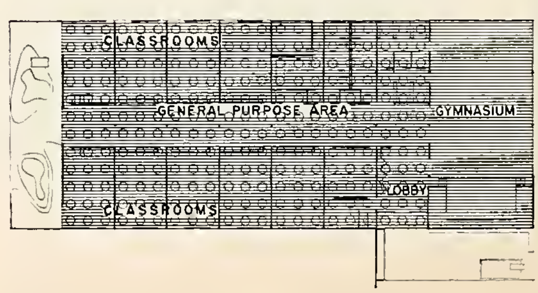


155 1949



Four Prototype Schools

152-155. Books, conferences, school architects, school planning specialists, all have their influence on the design of a school plant. But the greatest influence of all is the school building itself. Here are four classic examples of beautiful, functional school buildings which are prototypes of the schools we have today.

Academic classroom space for groups studying English, mathematics, languages, and social studies is not greatly different from the kind of space required for business education rooms, drafting rooms, or even science rooms. If properly designed they could be interchangeable without too much modification—provided teaching is done according to the activity concept. For example, the most profitable and enjoyable course the writer took in high school was a two-year course in Latin—the so-called dead language. But the teacher made it alive through a real activity program. The space provided for everything from ordinary formal teaching to a dramatization by the entire class of one of Caesar's episodes; the pupils made models of Roman houses and weapons, and they worked in groups to develop skills of pronunciations. Judged by the old, formal classroom standards, this Latin classroom could only have been called a laboratory. But is there really a difference between the classroom and the laboratory except that one may require more equipment? Since academic courses are requiring more and more equipment and reference materials, and since academic classrooms and laboratories have the common function of providing space for learning, it is reasonable to expect that their location, as far as the general characteristic of space is concerned, would be in the same zone.

Shops, however, may be considered as a separate case because of the noise and, sometimes, the dust. Then too, these spaces must be served by material and equipment suppliers. For these two reasons, it is generally desirable to have the shops located at the end of the building group.

The agricultural unit requires much the same type of space as the shops, it often has similar space requirements and may sometimes be located near them. It should be on the ground level near the terminal point of the building group so that it will be accessible to the agricultural fields and convenient for servicing and demonstrating tractors and other farm equipment.

COMPOSING THE MAIN DIVISIONS OF SPACE

The main divisions of space have been listed for both the elementary and secondary school plant, and some of their important space relations have been outlined. This next discussion will concern the composition of these space elements. It has been suggested that the possible combinations are numerous; when you get right down to it, the possibilities are limited only by the boundaries of our imagination and good judgment. It is exhilarating to think what might be done if a creative architect could completely free himself from the ties of existing architectural planning techniques and approach the planning of a school plant as if he had never seen one before. What a school plant that would be! But unfortunately we tie our imagination down by the things we see, and we simply have not had the opportunity to see enough good things.

Our skill and judgment in architectural composition comes, of course, through practice, through what we see, and also through what we read. Thus, one principal reason for this book. But in the opinion of the writer, the greatest influence on the architectural composition of the school plant has come not from books like this one, not from educators or architects, but from architecture itself. There seem to be four outstanding architectural examples that stand out as classics.

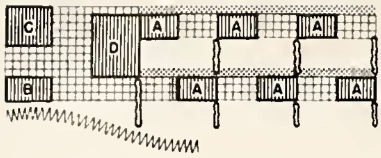
1. The first is Architect Richard Neutra's experimental school built in Los Angeles, in 1936 and sometimes referred to as the Bell Experimental School. Despite the contemporary newspaper reports that it looked like "a drive-in-market," "a hangar," and "a penthouse on Mars," it has since become a prototype.

2. The second came a few years later, and is also in California. Californians know how to grow good school buildings, and the Acalanes High School, near San Francisco, is a classic example of the way school buildings can grow. Its growth has been continuous since 1939, and, because of a very wonderful development plan it has grown into a beautiful, unified school plant. It was designed by Architect Ernest J. Kump, one of the best in the business. And so far as the writer knows, this was the first school to follow the "finger plan."

3. The third school listed here came about the same time and is quite different. For one thing, it is more compact. This prototype of single-story school design is the Crow Island Elementary School at Winnetka, Illinois, designed by Saarinen and Saarinen together with Perkins, Wheeler and Will—a warm and friendly school which is visited annually by scores of architects and educators from all parts of the nation. It represents the best in a pleasant, stimulating building for learning.

4. This school has never been built, yet it has had as broad an influence as any of these that have been built. It was first published as a project in the October 1949 issue of the *Architectural Forum* and is sometimes referred to as "The *Forum's* School." The school, an inspiration of Douglas Haskell, was designed by Architect Matthew Nowicki, one of the most highly skilled composers of architectural forms of his time. The uniqueness of the school is in its compactness and its versatility of space.

Although they differ greatly, these four schools have had immeasurable influence on architects and their products. Notice the great differences of space composition between the Acalanes High School and the Forum



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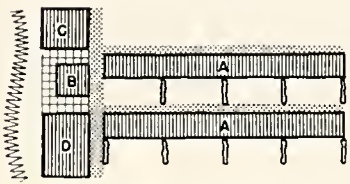

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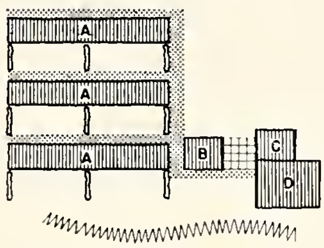

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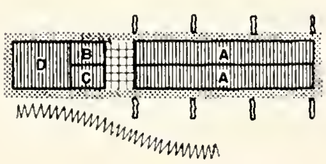

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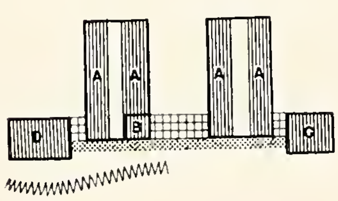

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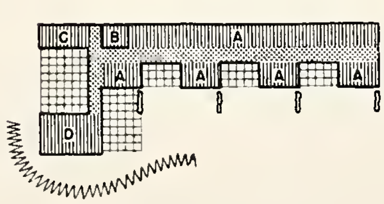

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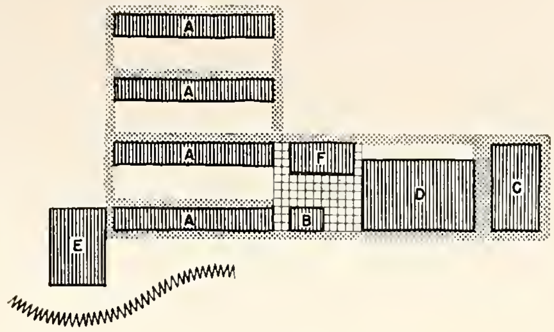
Composing the Space of the Elementary School Plant

156. These sketches show a few basic layout schemes for the elementary school plant. These are not recommendations; they are only indications of the infinite number of composition possibilities with exactly the same number of space elements. The letter "A" designates the Classroom Unit, either a group of classrooms or single classroom, as the case may be. "B" represents the Administration Unit, "C" the Dining Unit, and "D" the Recreation-Assembly Unit. No. 1 shows a layout which has individual envelopes for each classroom. The school at Santa Rita, New Mexico (Case Study 19) is an adaptation of this scheme. Scheme 2 is an adaptation of the finger plan, and one of the schools in Stillwater, Oklahoma is very similar to this layout. Scheme No. 3 is still another adaptation to the finger plan. Scheme No. 4 is a back-to-back classroom arrangement and is very similar to the new elementary schools in Laredo, Texas. Scheme No. 5 is sort of a combination between the finger plan and the low-perimeter school in Elk City, Oklahoma (Case Study 4). And sketch No. 6, for which there is a standing example in Port Arthur, Texas, is a cross between a double-loaded and single-loaded arrangement. These are only a few of many. They are not included as a catalog for layouts from which to choose a scheme; they are included here only to suggest more. The exact composition of any school plant layout will depend largely upon site conditions, environmental factors, esthetics, and the structure. For another and very stimulating layout, refer to Neutra's Ring Plan School, Case Study 56.

Composing the Space of the Secondary School Plant

157. Here are only a few of an infinite number of compositions of the main space elements of the secondary school plant. One of the reasons that these sketches have been included is to show the variation of shapes which the same number of space elements might take. The letter "A" represents the approximate space of the academic classroom spaces. "B" designates the Administration Unit; "C" is the Dining Unit; "D" is the Physical Education Unit; "E" is the Assembly Unit; and "F" is the shops. Consider Sketch No. 1, a finger plan adaptation bearing some relation to the famous Acalanes High School. Sketch No. 2 is another variation, one that might be adapted to a site having only a long narrow strip for building. Now look at Sketch No. 3, an adaptation of what sometimes is known as the court scheme. The Norman High School and a new Junior High School in Laredo, Texas have basically the same plan composition. Sketch No. 4 is another adaptation of the court scheme. Sketch No. 5 could be classified as a prime example of the low perimeter composition. At the time of this writing, Architect John Lyon Reid has a very similar scheme for a proposed high school in San Mateo, California. Case Study 66 and Sketch No. 6 is an example referred to by the trade as the campus plan. Note the many, many possible shapes which a school layout might take. The contours, size and shape of site, existing trees and vegetation, utility supply mains, prevailing breeze, and many other factors help determine what the exact shape will be.



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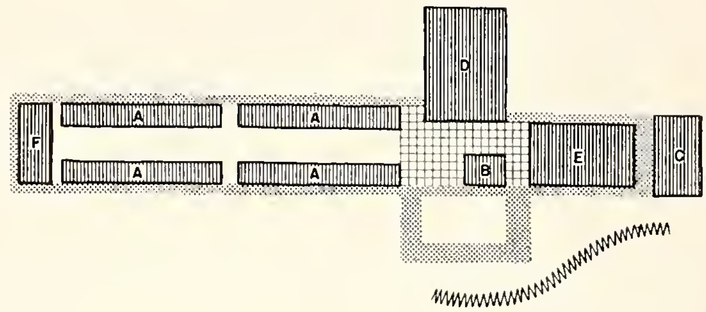

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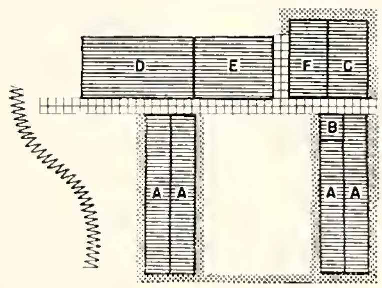

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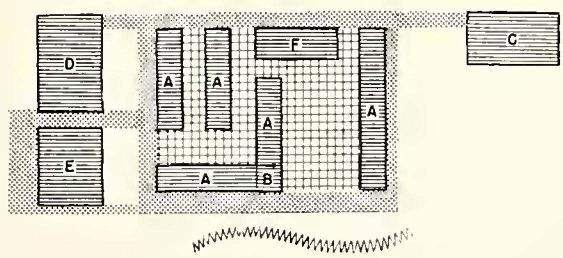

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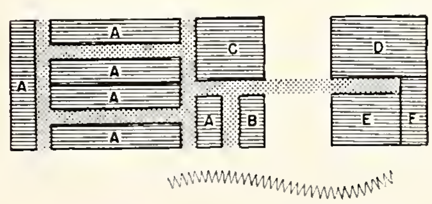

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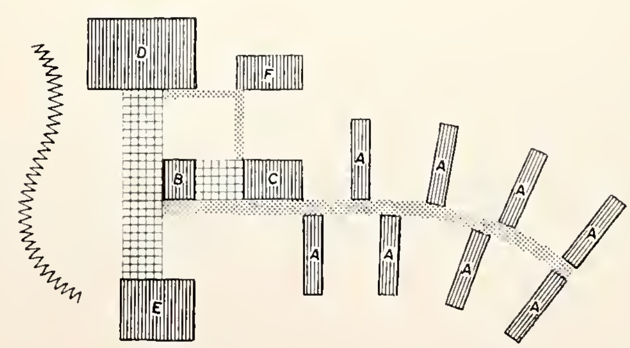

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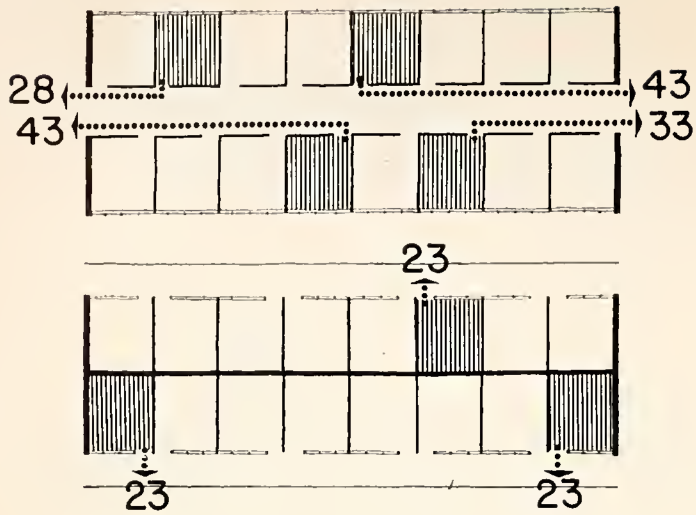


158. The pupil's safety is an important consideration in the arrangement of classrooms. The top sketch shows a double-loaded corridor arrangement. The large numerals indicate the number of seconds calculated for the various classes to leave the building in case of an emergency, under well-drilled conditions. If the same number of classrooms were arranged back to back with perimeter corridors, the time of emptying the building, of course, would be considerably reduced, as shown on the bottom sketch.

School. In the California building the space elements are composed in "fingers" along connecting corridors; these narrow fingers of classrooms and laboratories are usually bilaterally lighted and ventilated, and are spaced far enough apart so that one finger will not block the light or breeze from the others. The composition of the other school is characterized by its wide, spacious interior area and its versatile quality; its circulation space has multiple functions. The finger plan composition is loosely jointed and has tremendous qualities of expansibility; additional fingers can be attached, economically and efficiently, will even enhance the beauty of the plant. But it does not have the advantage of least exposure to the weather through an economically short perimeter. The finger plan composition is well-adapted to large, rolling sites where fingers can ride the contours, and the short perimeter composition is excellent for small flat sites. Each has its own advantages.

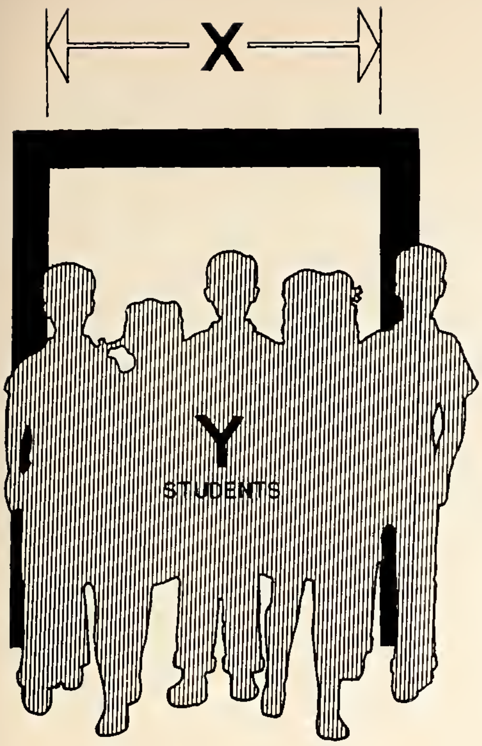
But it is enlightening to hear discussions of the pros and cons of these two basic plan layouts.[28] Architect Henry L. Wright, who has had much success with the finger plan, considers this type of layout very economical in the long-range. He says, "I think this philosophy (the use of the finger plan as a skeleton on which the school should grow) has been one of the greatest influences on school design in California, since more attention is paid to the functional use of school buildings, wherein the architects design from the inside out. The one-story, single-loaded corridor permits a more flexible plan, better lighting and ventilation at no added cost, since one-story buildings with limited areas may be constructed of the minimum type of construction for public buildings allowed under our building codes." Douglas Haskell takes the other side, and in an editorial which appeared in the December 1949 issue of the *Architectural Forum*, he says, "There is reason to believe that even in California the heyday of the spread-out finger plan type of school is past . . . finger plan schools will no doubt continue to be built in profusion but not in the larger cities." Mr. Haskell argues that in the cities where land is at a premium, the short perimeter appears to be more practical. Here are two extreme ways of composing the divisions of a school plant. It is good to know that we have both of them, because each has a proper place to fill.

CIRCULATION: TRAFFIC PATTERNS OF PUPILS

How pupils move about the school plant is basic information which obviously every school planner must have. But so many think of traffic only in terms of corridors and walks, not in terms of pupils. A corridor should be so wide, and walks should be such and such a width. But what are the objectives of corridors and walks? Of course, they are to facilitate pupil and faculty traffic and sometimes that of visitors. But in what terms? For how many people? Under what conditions? For how long a period? To say that a corridor should be not less than 8 or 10 ft. wide is not only over-simplification; it is also expensive talk. Why should a corridor have to be 8 ft. wide if it serves only one or two classrooms? (And sometimes they do. Refer to the finger type corridors in Case Study 27). Why should an outside corridor with a wall on only one side be the same width as an interior corridor? Why should corridors in elementary schools which have self-contained classrooms and minimum traffic be the same size as those in high schools? Why should corridors with lockers be the same size as ones without lockers, since when the locker doors are open, the effective width decreases at least 2 ft. without any pupils present? The questions above are a protest against fixed minimum or maximum corridor widths unless they are made in terms of number of people to be served, the time involved, the length of the runs, arrangements, and distinctions between inside and outside circulation.

There seem to be three major considerations of circulation: (1) safety of the pupils, (2) convenience, and (3) educational value. A discussion of the first two will come under this heading, but the third, the most neglected consideration, will be discussed in a section of its own. It deserves it.

Safety, the first consideration, concerns mostly fire and accidents. In case of fire, the first objective is to empty the school building in the shortest possible time. The length of the time seems to depend on (1) how well the pupils have been trained for such emergencies, and (2) how well the circulation area has been planned



Y STUDENTS PER MINUTE	X FEET OF OPENING
100 STUDENTS	3′ OF OPENING
200 STUDENTS	4′ OF OPENING
300 STUDENTS	6′ OF OPENING
400 STUDENTS	8′ OF OPENING
500 STUDENTS	10′ OF OPENING
600 STUDENTS	12′ OF OPENING

Formulae for Openings

159. This diagram provides information for determining the size of opening. The size of opening will be determined by the number of students which must go through it in a specified period of time. For example, if 400 students are required to pass through an opening in one minute, it should be at least 8 ft. wide.

for efficient traffic flow out of the building. The first, of course, is an administration problem; the second is an architectural problem, and the one to be discussed here. First, in order to get children out of a building, the corridors (or the area of circulation, since some schools do not have corridors as such) must be large enough. Let us consider, for example, a recent school constructed in Port Arthur, Texas (Case Study 64). In this particular case every classroom is within 30 ft. of an exit, no two classrooms' lines of traffic cross; and no more than two flow lines converge at any exit. So far as safety is concerned, the corridor could be much smaller than the 7-ft. width which it is. Let us assume, and it is a pretty good assumption, that a pupil can walk 300 ft. per minute. If 30 pupils in a classroom were lined up 3 ft. apart, it would take a little under 20 seconds for the last pupil to get out of the classroom door; then since he would have 30 ft. more to go, it would take him approximately 6 or 8 seconds more, or a total of 28 seconds. That is good in anybody's fire drill, even if our calculations are 300 per cent off. So for safety's sake, if teaching areas could be so arranged for a disbursement of traffic in single lanes, the size is not so important, since a pupil can easily walk in an area 22-in. wide.

Let us take another example. Refer to the accompanying illustration. The top sketch is a floor plan of the typical double-loaded corridor type layout with eight classrooms on each side of the corridor. If we empty a classroom (the second from the end, for example) and have the last student walk about 30 ft. to the nearest exit, it will take him about 28 seconds. Now if the hall were large enough to take eight lanes of traffic (8 times 22 in., or nearly 15 ft.—Oh my!) then the pupils in the middle classrooms could get out of the building in about 43 seconds. But chances are, since the corridor would probably be just a little more than half that wide, it would take twice as long if everybody acted properly. These recommendations which say that corridors should be at least 8 ft. wide certainly would apply to a double-loaded corridor school like this one. Now look at the bottom situation. It is a back-to-back arrangement as in the elementary school in Laredo, Texas (Case Study 87). The entire school could be emptied easily in 23 seconds. This applies to any outdoor corridor type of classroom.

The size of the exit itself should also be considered. An inside corridor could be 20 ft. wide, but if it had only a 3-ft. exit for a great flow of traffic, it could be very unsafe. The accompanying chart gives a basis for sizing exit openings. Note that it has been broken down to numbers of pupils involved in the flow of traffic. For example, if an exit is to be large enough to handle 300 children in one minute it should be 6 ft. wide. It should be pointed out that one minute is considered very good fire-drill time.

Accidents in areas of traffic lines often occur on projections such as drinking fountains, outswinging doors, and even open lockers. The lockers obviously have to be controlled by the students, but doors, fountains, and the like can be taken care of through good planning. Some standards make allowances for 8-in. projections. But why 8 inches? Need there be projections at all?

The second consideration of circulation of pupils in the school plant is convenience. This ties in very closely with the consideration of space relations. Not all school planners agree as to how important is the convenience consideration. Certainly it must vary with the ages of children and with the type of educational program. Four blocks to a first grader is a much greater distance than it is to a high school senior. Convenience in the high school which operates under a class schedule certainly seems to be more important from the point of view of the pupil than it is in elementary schools which have self-contained classrooms. Let us trace the flow pattern of a high school student in two extreme school plant layouts to see how his walking distance might be affected. Refer to the accompanying diagram The right diagram contains the flow lines of a student during a typical day within a finger plan type of secondary school. The left diagram shows similar flow lines for a low perimeter type secondary school. The day's schedule is the same for both situations. The right diagram could very well represent a school like the Alcanes High School. The left diagram bears close similarity to the layout of the junior high school in Electra, Texas.

Now let us trace the path of a pupil from the time he first gets off the school bus early in the school day until he gets back on it at the end of the day. remembering his procedure is the same for both schools. Start at No. 1, where he gets off the bus. He walks to his homeroom at No. 2 and gets settled for his day by putting his books and wraps in order. His first class is Algebra so he proceeds to that classroom at No. 3. The next class is English, at No. 4. The next activity of this day's program for him is physical education; so he goes to the gym at No. 5, dresses for outdoor activity, participates in a game of baseball, returns to his gym locker at No. 6; then proceeds to his homeroom at No. 7 for a short homeroom and counseling activity. Before lunch there is a special assembly, so he goes to the auditorium at No. 8. After the program he goes directly to the cafeteria at No. 9, and spends some time on the terrace before going to his next course, at No. 10, for social studies. His last class is in mechanical drawing: so he proceeds to No. 11. After this he returns to his homeroom at No. 12 to pick up his wraps and any books which he may wish to take home, and proceeds to the bus, which is waiting at No. 13. Of course, this is strictly a hypothetical school day, and it is intended to serve only for comparative purposes. Figure it this way: Here we have two situations with two constants and one variable. The day's schedule is the same in both, the space areas are the same in both, and the only difference between the two schools is the composition of these space areas. Then what is the result of comparative analysis?

Here is what we will find. By tracing the steps of the pupil in each of these situations, but omitting the distance which he travels during the game of baseball and after he eats his lunch, we will find that in the finger plan school he will have traveled *more than twice the distance* he walked in the low perimeter school. Apparently the low perimeter plan is more convenient. But how important is this? Perhaps the importance is in the time element. It would take twice as long between classes, and such time adds up. But maybe the pupil can benefit by relaxing a little because of this extra time and extra walk. So you see, there are arguments for both sides. The only recommendation that the writer can make here is simply that if there is a problem of convenience, the approach to solving it might be made in this direction.

There are other interesting comparisons that might be made in this between these two plans. Let us consider again safety. For example, it would take a great deal more time to empty the low perimeter school, and it can be said that although the pupil in the finger plan type school must go the greater distance during the school day, he goes the shorter distance during fire drill. Again, if in one plan the pupil must travel twice the distance he travels in the other, it might be reasonable to expect that one plan would require twice the circulation area. That would be a very important cost factor if all the circulation area were enclosed, heated space. But if the low perimeter school has enclosed corridors, which is probably the case, and if the finger plan school has outside corridors, which is generally the case, the cost of the circulation space would be about the same in the two schools, since outside cost about one-half as much as inside corridors. This is a good analysis if that comparative unit cost is correct, and if the widths of the circulation areas are the same. Of course the variable will depend on the specific case.

THE EDUCATIONAL VALUE OF SPACE FOR TRAFFIC FLOW

Important as these basic considerations are, we must eventually get around to questioning the educational value of space used for student traffic flow. When we get right down to it, space just to walk in does not do education very much good; dollar for dollar the space for corridors is not worth as much educationally as, say, the space of a classroom. An architect who plans houses goes to a lot of trouble to eliminate mere hall space. The one who is writing this book has designed two different homes for his family during the last ten years; neither has halls, and he doubts that he will ever be able to afford a home which has the luxury of hall space. He also doubts that the typical school district is in any shape to afford corridors used only for walking. In Chapter 2, it was pointed out that time spent in the secondary school corridor about equalled time spent in any one laboratory or classroom. That time could be well spent on achieving some of the educational aims. In the first section of this chapter

the open plan was mentioned as being one of the innovations of contemporary architecture. Actually it concerns not only the elimination of these room cells which constitute the typical building, but also the elimination of the halls which tie them together. The open plan, therefore, gives versatility to circulation space. The first of the houses just mentioned was so arranged that dining was carried on in the space ordinarily used as an entrance hall and connecting element between the kitchen and the living room. There is good reason to believe that this same planning technique could be used in the school. Later on in this chapter this possibility will be discussed. Another scheme which might very well be adapted to schools is a combined use of circulation areas planned by the writer for a house in western Oklahoma. Generally the houses in that area have entrance halls which sometimes serve as waiting areas or small sitting areas; then, of course, there is always the hall which connects the bedrooms and bath, and which generally affords circulation space to the living room. In this house these halls were combined, and privacy was achieved through a wall of translucent glass which served as an accent for the entrance as well. Sitting areas or small lounges could very successfully be worked into customary school corridors, and could provide space for the social function of education emphasized in Chapter 2.

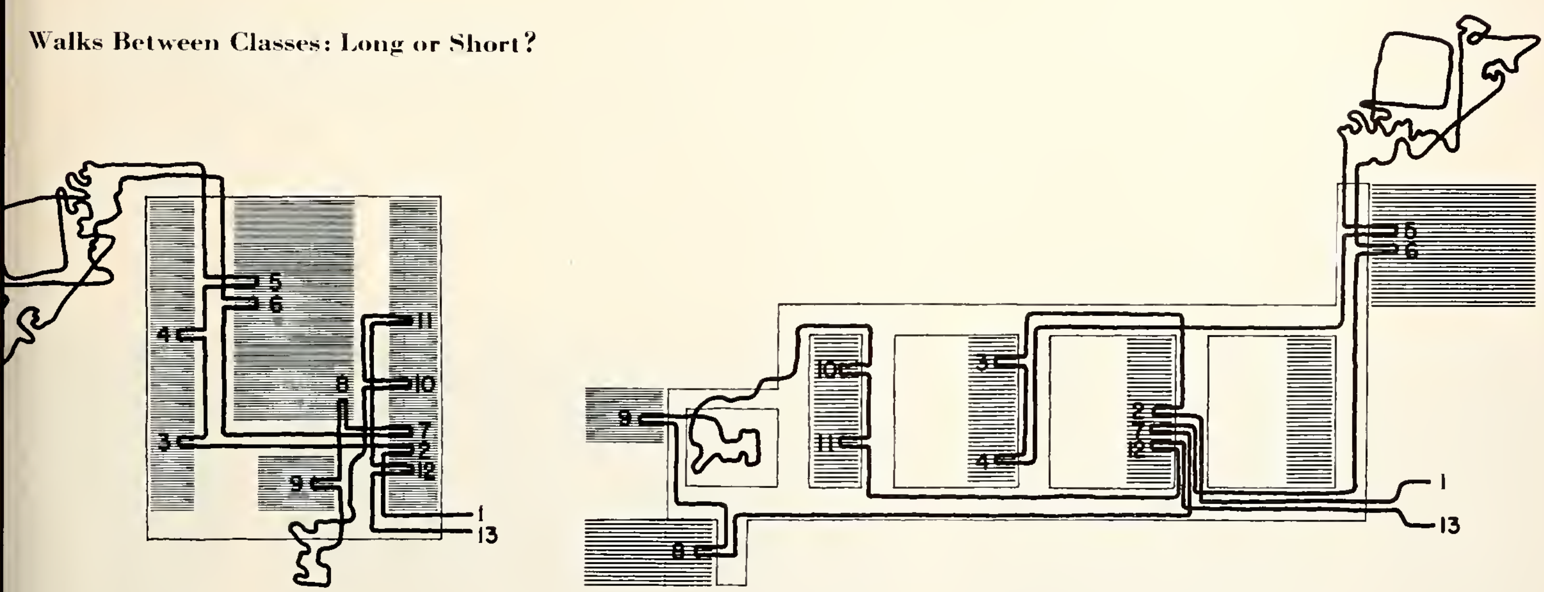
Phil Will sums up this problem of versatile space for circulation this way: "I believe that one of the essential purposes of corridors and adjacent spaces, particularly in high schools, has been generally overlooked by both educators and architects. While education can be a pleasant process to the pupil, it is work involving tenseness and a high degree of concentration. The brief release which occurs between classes is important. We must recognize the period of passing between classes as a brief but important social period, and do all in our architectural power to encourage proper social contact and relieve the tensions built up during the preceding academic period."

With such objectives, the typical dark and monotonous interior corridor with its rows of lockers becomes totally inappropriate and precisely destroys that which we seek to achieve.

The breaking of the monotonous length of our corridor runways into bays and alcoves, the use of colored furniture, light—and perhaps above all, glass—are most important to our results. Our Norman High School is a case in point, as are also our Keokuk High School, our Barrington Countryside School at the elementary level, and many others.

The Norman High School Student Center is really an extension of the concept expressed above. Here we recognize the natural travel patterns of the student; which bring him frequently to his book locker. What could be more appropriate, therefore, than to develop the space adjacent to his locker as a relaxing social center, the casual use of which will be encouraged

Walks Between Classes: Long or Short?



160. The length of the flow pattern in this finger plan is twice as long as in this low-perimeter plan. But is it necessary to cut down these long flow lines? Some educators argue that short flow lines save time between classes which could be devoted to classroom teaching. Others argue that the students should have more time between classes in order to develop some of the social aims of education. So perhaps the distance which a student has to walk to get from class to class may not be so important as other factors involved in the finger plan vs. compact plan argument. These include economy, flexibility, site utilization, terrain, and orientation.

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Indoor Corridors

161-165. Corridors in schoolhouses need not be the dark tunnels which we have in most of our schools today. They can be well-lighted, attractive spaces which serve many functions other than just places to walk. The first two illustrations (161-162) show that the corridors can be beautiful and pleasant. How unlike these are from the dark corridors of schools built only a few years ago. The next three photographs (163-165) illustrate that circulation space can double also for many other functions. In the present high school program, a pupil spends as much time in corridors as in any one classroom during the school day. Is not that reason enough to make the corridor a pleasant place?

Outdoor Corridors

166-170. The popularity of outdoor corridors has increased considerably these last few years. Some educators argue for outdoor corridors on the basis of low maintenance and disciplinary advantages. But probably the most outstanding reason for the increased use of outdoor corridors is the simple fact that, if properly designed, they cost less than enclosed, heated space. Here are a few solutions to the outdoor corridor problem. The first photograph (166) shows a school in northern Oklahoma (0° temperature zone). It is located on the south so that the building itself is a barrier against the cold north winds. The corridor roof serves also as a sun shade to the south windows. Notice the concrete curb

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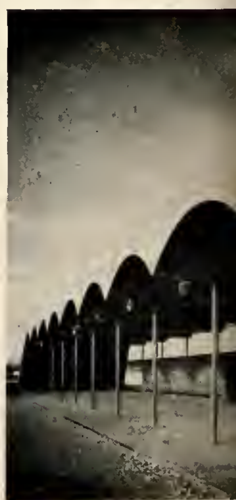

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on which the little boy is seated. It serves not only as a seat for putting on skates and rubber boots and a place to put books and lunches before school but also serves as a guard for the projecting windows, which is definitely a problem where outdoor corridors are used. The second photograph (167) of one of the fine schools of the nation shows these outside corridors grouped around a social terrace. The middle photograph (168) is a combination outside corridor-playshed-unloading dock. This unique design consists of a multiple number of concrete vaults so arranged where they each counteract the thrust of the others. The next photograph (169) is of a high school designed by world famous school architect Ernest J. Kump. Note the lockers to the right; certainly this solution solves the locker ventilation problem. The last photograph (170) shows an outdoor corridor which connects classroom wings. Are outdoor corridors feasible? Certainly the ones shown here have proven themselves successful. But can they be used in colder climates? They are being tried now and only time will prove their merits. But it is reasonable to expect that their use will increase. Isn't it true that most northern colleges have uncovered walks which students must use to go from class to class? If it works in the colleges, it should work in the high schools—even in elementary schools, particularly if self-contained classrooms are used.

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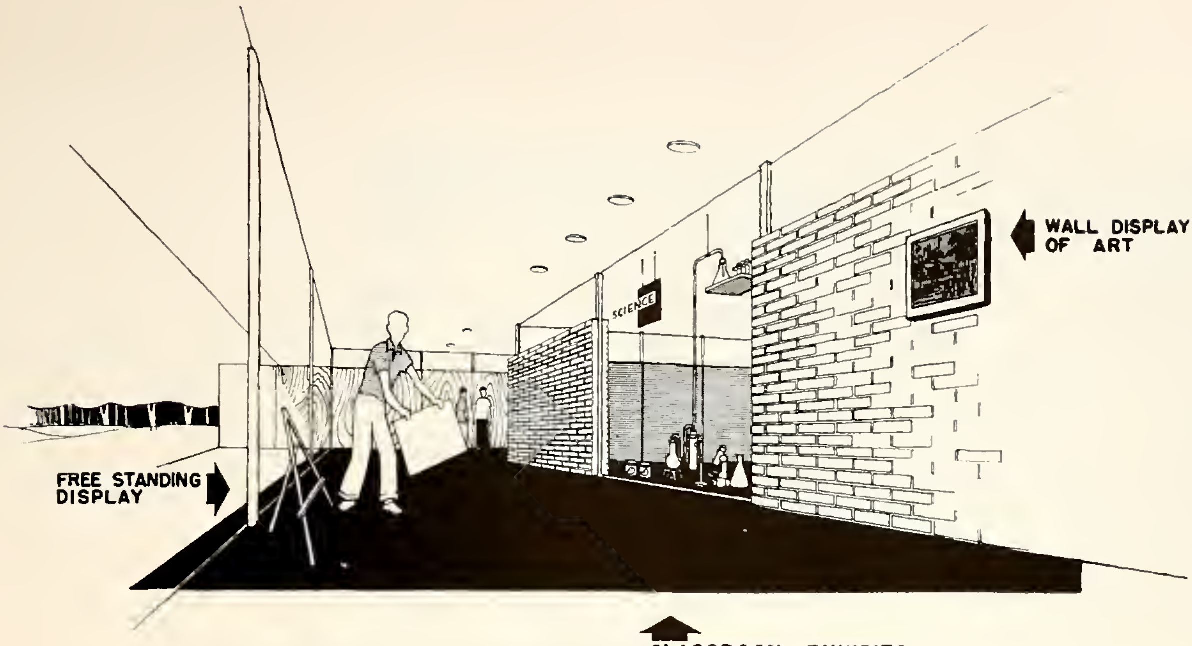
by its easy availability? Here we have convenience, space, openness expanding into the outdoors, and full opportunity for color, texture and furnishing. This space also serves as community center, lobby, administration waiting space, and leisure reading area for the library. This is only sensible economy, and will in nowise exceed its capacity."*

Phil Will's fresh thinking concerning the social aspect puts a new light on circulation space. But there is still another very important consideration. Functional corridors can serve education. The fact that so much time is spent in corridors should mean something. We should take a hint from merchants. The flow of people passing their stores is very important to their business, although the time it takes a person to walk by a store is very brief. The merchant, therefore, does all he can to make this brief period of time pay off. He does it by having eye-catching displays in show windows. The latest trend in commercial architecture is to open up the entire store front with large areas of glass, and let the store itself be on display. Why should not this work in a school plant? Why not have each classroom or laboratory be so designed that passersby might be sold on the subjects involved? Take a look at the accompanying illustration. Let us take a lesson from the merchants and from the architects who design their stores. Consider the circulation space adjacent to the science laboratory. Here is good advertising space to sell the pupil on the benefits of science. Let us now consider the pupil who passes this area on the way to another classroom or laboratory. Suppose he is not particularly interested in science, simply because he has never been exposed to it. When he passes by this area adjacent to the science room, instead of the conventional repellent blank wall that does not quite hold back the chemical smell, there is a "show case" which contains a display of chemistry at work (and the fascination which goes with it). He cannot help pausing, even for but a brief moment, and by doing so he automatically takes in some of the knowledge that goes with visual aids of this sort, and he will probably be stirred into some interest in chemistry. The author speaks from experience. In high school he never took chemistry and had no interest in it whatsoever. The odors which came out of the chem lab only gave him a feeling of ignorance and a fear of the unknown. The wall which separated the chemistry laboratory from the corridor was like a dam which held back a tremendous force which could hurt people. The door to that laboratory was a gate that required a ticket which that high school boy not only did not have but did not give a hoot about getting. When he went to college it was a different story. Although he still did not have to take chemistry, he was exposed to it simply by passing through the corridor and glancing into the glassed-in laboratory. First it was just a passing interest, so to speak. But as time went on, his glances into the laboratory became short stops. A surprising amount of interest was created and knowledge picked up. The glass wall helped sell chemistry.

*by letter.

The showcase idea works not only from the outside corridor, but also from the inside of the laboratory. Much learning is involved when the students of science prepare exhibits from the showcase. One must know his subject if he is to explain it to the uninformed. Such exhibits could be changed monthly or even weekly, and be a part of the educational program. Of course, the same idea of opening the classroom or laboratory to the corridor would apply to other courses of study. The social studies group could maintain a continuous exhibit of current events and various phases of political activities. The language groups could display models and travel posters which would give information about the country and the language being studied. Even the mathematics and English classrooms could prepare very stimulating exhibits. And of course it would be a natural thing for shops and art rooms to have showcases or be showcases. But what about the disturbing factor of pupils passing in the hall? If classes of high schools continue to be on a schedule, of course there is really no great problem. But even if a few people should walk down the corridors during classes, the pupils will not be distracted if the classwork is interesting enough. The traditional classroom cell is for dull classwork.

Will such a scheme work in the elementary school? In Port Arthur, Texas, there is a recently completed elementary school which has large glass walls in each classroom very similar to the sketch shown here. The teachers and students not only love the openness and cheerfulness (again the fluidity of space), but they use the space to great educational advantage. During one Christmas season each classroom had its own exhibit (and some classrooms served as their own exhibit areas). To walk through the halls of those schools was like walking through a spirited village on the day of Christmas Eve. Each classroom displayed the work of the students based on the Christmas theme. You could tell there was competition in the air. Each class was as much interested in the other classes' work as in its own. After the holidays these exhibits were replaced with others having to do with the various units of work being carried on by each class. There were showcases which showed all of the modes of transportation by the display of small models of cars, trains, and airplanes. Other elementary teachers and their respective students made window or room displays based on shelter, on nature, on history, and so on. Through the stimulation of a creative principal, Miss Gladyne Robison, this interrelated program between classes was to the benefit of the pupils. If opening the classroom out to the corridor worked for Port Arthur, there is good reason to believe it will work elsewhere. Maybe this is a step to the "open plan" and "family living" applied to the school.



171. The educator can take a lesson from the merchant. The merchant knows the educational value of store front show cases. He is an expert in instantaneous visual education. He knows that the brief instant that a person passes his store window is time enough to give an impression—good or bad—of the merits of his goods. He realizes that the sidewalk in front of his store offers real educational possibilities in the interest of his goods. Can this experience be applied to a schoolhouse? Consider the sketch above. A science lab, for instance, could be so designed as to have a large plate glass show window. The students who have keen interest in science could provide interesting exhibits for those students who are not taking science and who have only a casual interest. Such exhibits could be changed weekly and would have great educational potentialities. When school planners learn that corridors can serve many more functions than mere places for walking, then we can expect marked improvement in educational architecture.

CORRIDORS AS TEACHING SPACE

Circulation areas, too, can be used for classroom teaching. Remember the case mentioned in Chapter 3 of the school in Ferndale, Michigan, where the classes moved into the rooms before the glass corridor partitions between the classroom and corridor were installed, and the teachers used the corridor as an extension of the classroom? This use of the corridor for teaching purposes was discovered quite by accident, but Architect Eberle Smith knew a good thing when he saw it and used the circulation space as a planned extension of the classroom on one of his next schools. Refer to the elementary school in Plymouth, Michigan, Case Study 57. Phil Will talked about a similar situation in the Barrington Countryside School in Barrington, Illinois. At the other end of the country there is another example of a multi-functional corridor in Clinton, Oklahoma; refer to Case Study 58. Corridors, too, can be used for multiples of other purposes. Refer to the school near Lansing, Michigan, Case Study 34, to the high school in Newton, N. J., Case Study 26, to the student union at Texas A & M, Case Study 24, to the very nice little parochial school in Fairmont, Oklahoma, Case Study 22, and to the all-purpose corridor of the elementary school in Elk City, Oklahoma, Case Study 4. This should be proof enough that even circulation space can have versatility and be made to work for education—and without any extra money from the taxpayer.

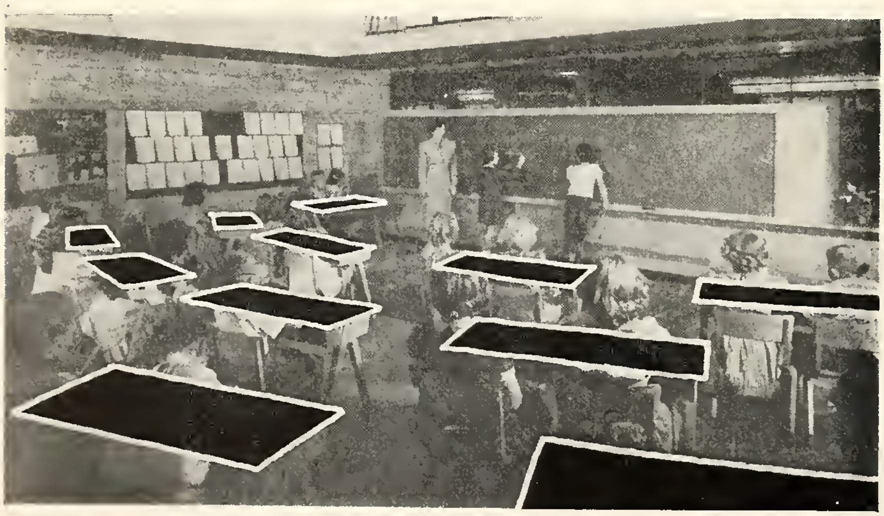
THE DESIGN OF THE SPACE DIVIDERS

Circulation space is not the only element besides the classroom that can be made to work more efficiently for education; even the walls can be put to more efficient use if properly designed. First let us analyze the work space that is used for teaching. The process of teaching requires two distinct work surfaces—horizontal and vertical. The *horizontal* surface, of course, includes the surface of the floor plane necessary for the students and the teachers to walk during teaching situations. In the lower grades especially the floor is also used as a surface for work which requires larger surfaces than the ordinary desks or tables, for example, work connected with making large graphic layouts or with constructing models. The floor has many other uses as a horizontal work surface. And the classroom's desks and tables provide for most of the work done on the horizontal plane. Everyone considers the horizontal work surfaces as obviously necessary.

Apparently this is not true in the case of the *vertical*

172-174. "The process of teaching requires two distinct work surfaces . . .

vertical work surface including chalkboard and tackboard space . . .



and *horizontal work surface* such as tops of desks and table."

work surface. With the exception of the customary amount of chalkboard surface and a much smaller amount of tackboard surface, the walls of most classrooms are of hard plaster and seldom used for teaching purposes although teachers say that more and more tackboard space is needed. The expanding use of visual materials has given the vertical surfaces of classrooms exceeding importance. A wall is not a wall any more; it is a teaching device. It can offer a place to display students' work, places to hang charts and maps, and places to bracket shelves to hold reference books and exhibits, not to mention space for chalkboards and tackboards. Properly utilized, walls can help the teacher teach.

The classic example of this use of walls is in the Crow Island Elementary School, one of the four great schools already mentioned. All of the classroom walls were made of soft wood panels, where every square foot of surface could be used for tacking up visual aid materials or student work. The critics raised their eyebrows high because the "pupils actually stuck thumbtacks in the walls." But these soft wood panels were not mere walls; they were vertical work surfaces which helped divide the space of the instructional area. Architects Larry Perkins and Phil Will first used this device over twelve years ago, and they still think it is a good idea. So does the author.

This point was driven home most effectively when the writer attended a meeting of the National Council on Schoolhouse Construction and heard Dr. Charles C. Bursch speak on classroom design. Dr. Bursch, one of the deep thinkers in this field, pointed out that partitions in classroom wings can do more than just divide the space into cubicles called classrooms. He said that

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by DOUGLAS HASKELL

There's one aspect of school building for which it is impossible to lay down rules, or to say how things are going to happen. You can call it "architecture." Or again you can call it "imagination."

An episode of 1949 shows something of the way its unpredictable law works. In 1949 I was engaged with my associates on editing a special school issue of the magazine *Architectural Forum*. We started by thinking that the most "advanced" ideas in the school building of the time were coming from the West. We thought that the West, being naturally more progressive than the East, had developed the "finger plan" to a high degree and that the next step would be the gradual spread of the "finger plan" eastward. The "finger plan" as you know strings classrooms along the side of corridors, lines up a series of corridors parallel to one another, connects them all with a trunk passageway. But as we studied that eastward spread of the "fingers" we began to be unsettled. Things happened to the finger plan when it hit the cold country—things we couldn't well argue with. One was that the classrooms got doubled—the corridors got to be "double-loaded" as the saying is instead of "single-loaded." This acted to cut periphery, cut heat losses, increase compactness.

Another thing upset us. Land was getting costly, especially in towns farther east. The "finger plan" is a great grasper of land. The East needed something more compact.

And then something struck me, out of a totally different field of building. A remarkable architect with the remarkable name Mies van der Rohe, a genius America acquired in the '30s when Hitler was persecuting genius (just as Huguenot genius had earlier been disseminated after persecution in France), had been thinking in a totally different direction. Fascinated with the American "loft" building, a tall building of great big undivided floors which tenants would subdivide for offices, for storage, or for light manufacturing, Mies had seen here a key to 20th century needs. The loft was infinitely *convertible*. Just because its framework was utterly regular and unchanging the spaces inside could be made utterly irregular and infinitely changing. Moreover periphery was held to a minimum and plans were utterly compact, saving land.

The question how to apply Mies's principles to schools began to occur vaguely.

And then Walter Bogner, school architect connected with Harvard, gave another impetus. He began thinking of economy in terms of eliminating that greatest waste space of all, the connecting corridor. He devised some *multi-use* corridors. They were wider than the usual one, could be used for auxiliary activities such as elementary shopwork or crafts. (Bogner's corridors were "single-loaded" ones and consequently stood next to windows.) This widening of corridors by Bogner started a train of thought. Why stick with the "standard" corridor? Why be tied to it? And what ties us to it? The fact that corridor walls are made structural, help to hold up the roof! Let's get away from that hampering restriction!—If the school were built like Mies's lofts, all in

they offer vertical work space to help carry out the teaching program, and that planners are terribly limited when they think of such partitions as being only walls. He said, "Partitions bear closer relation to furniture than to walls." This talk was a real inspiration to the writer and it led to the development, by the writer and his associates, of a partition which may be the first step towards wholly functional partitions. (For another approach to designing functional walls, refer to Architects McLeod and Ferrara's storage wall partition, Case Study 29.)

Like most worthwhile things, the idea of the teaching space dividers did not come about without a long period of deliberation and study. Even before Dr. Bursch's speech, the author and his associates—John Rowlett, William Pena, and Cleon Bellomy—would discuss at "coffee time" the classroom partition—what its real purpose was and why we make them the way we do. We would bring up such questions as these: Does it make sense to put up expensive wall surfaces, such as plaster, then partially cover them up with chalkboards and tackboards? Does it make sense to make nonloadbearing partitions fireproof, then cover them up with combustible materials such as corkboard and fiberboard chalkboard? Why do insurance companies make such a fuss about wood partitions, when actually there is more wood in the furniture and built-ins? Does it make sense to build heavy, masonry partitions when there are so many cases where such partitions must be moved because of school enrollment and curricular changes? But if light, movable partitions are used, what about the sound transmission? Do partitions really have to be soundproof? What are the basic considerations of planning classroom partitions? How can we

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"skeleton" construction, then corridors as well as rooms could be narrowed or widened at will.

The idea began to take shape of a new kind of school plant.

To begin by keeping the "double-loaded" feature found so practical by the East—a central corridor with classrooms *both* sides.

Then to widen the corridor itself, so it could be used for overflow space, cafeteria use at noon, other things, besides mere passage.

—But it would be necessary to do something different about light! One reason for the Western finger plan had been the ease of bilateral daylighting. The rooms were all strung one deep, and so each was exposed on two sides. What about lighting a deep compact plan? Well, what would you do in theory? In theory, obviously if you couldn't get light to penetrate your new deep space from the sides you would have to get light from somewhere else. It would have to be from the top! And how is top-lighting achieved in vast compact interiors of today such as factories? Through the roof! So lighting would have to be skylighting through the roof.

Or again there was another answer—electric light. By now the question was serious whether a school could not anyway get light to the interior cheaper by electricity than by some of the fantastic construction of elaborate "sections" with clerestories and whatnot else in Rube Goldberg profusion.

Anyway once you began to think of deep space for the sake of compact plans you had to rely less on windows for light, rely on them more as just a source of view, an opening to the world.

In thinking about toplight one came in contact too, with another development that started far away from schools. When plastic blisters were developed for the nose of airplanes a fascinating shape had developed, and the plastic manufacturers wanted a postwar outlet. They hit on plastic "blisters" as a kind of sky light. It would be simpler to install than conventional glass. Provided the manufacturers could lick their technical problems, it would be another availability.

So, taking all these things together, I began to see the possibility of a new plan type in schools—not as a replacement of finger types, which have their great advantages, but as something else for different circumstances. The new school would be built with skeleton construction in regular square bays of roof area held up by posts perhaps every 24 feet in each direction. It would have a wide multi-purpose corridor down the middle, lighted from the sky. And the classrooms would be sky-lit, too, along their inner, corridor side—accordingly they need no longer turn their long side to the outer wall. They could be turned transverse with only a short side exposed. Travel inside such a school would be short; supervisory distances greatly reduced; outside wall and heating costs cut to the bone.

When this idea was taken to several of the "regular" school architects, they all turned it down. All had reasons why it would not work.

design a partition without knowing what the problems are?

It became evident that there must be a clear understanding of the functions of partitions before advancements could be made in a classroom design. We knew that the partition should be more than a mere stacked pile of concrete block with mortar in the joints. We knew that this space divider must be more than a sight or sound barrier; Dr. Bursch told us that. But we had never sat down to *program* the problem of the partition as we had done in programming the general space needs. So we did, and this led us a bit closer to the teaching space divider. This is a good illustration of the general rule that when we carefully analyze the problem, our approach comes very close to a solution. Our study of the functions of a partition brought out these bases of design:

1. A partition, serving as a classroom wall, is actually a vertical work surface and should be designed as such, with every square foot usable for teaching purposes.
2. Because of enrollment and curricular changes, partitions should be light, non-loadbearing walls so that they can be easily and economically moved.
3. If continuous windows are used in classrooms, partitions need not be more resistive to sound transmission that the 30-decibel loss afforded by sound traveling in and out of adjacent windows.

That was our start. The partition between classrooms should first be a space divider which also serves as a vertical work surface, and second be easily moved; and until we find a better way than the use of continuous

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And I had asked some of the best.

But Matthew Nowicki, the brilliant Polish-born young architect whom the US had acquired—again as the result of European persecution—had more imagination! He had not been tied to routine. It seemed as if he grasped the theoretic part of the exposition even faster than I could say it. In no time he came back with a beautiful sketch which he further developed after criticism and which became the "*Forum* school for 1950." It had all the elements which I could not have given it—the sense of scale, the nicety of arrangement, the brilliant decorative treatment which would have made the school, if actually built, a gem.

Best of all, Matthew had given such an appeal of beauty to his drawings that other imaginative architects were enticed into taking seriously this child of imagination.

I won't labor the point in declaring that the episode had some importance: it opened up a whole new world of possibilities *because* it released the stranglehold on imagination that had been put on it by the one good idea of the finger plan. People were so sure that the finger plan was "progressive" they were proud of just repeating it ad infinitum, saying, "look what a good boy am I." It was good, but it was an example of the good being the enemy of the best.

No sooner had Nowicki fastened these ideas of a compact school to paper than other brilliant men took hold. It is not out of place to declare that one of these open minds was the author of this book. Bill Caudill very soon built the actual elementary school with improvements of his own. Another was his friend John Lyon Reid of San Francisco. In John's hands a much bigger application is being made at the scale of a large high school, and there is being explored another aspect which Nowicki and I had not reached (although it was implicit all the time in the idea) and that is the interior court as a sunny, leafy "escape hatch" in a checkerboard plan of rooms. Mediterranean architects know well what I mean.

Imaginative ideas come into architecture through no one person, as this episode shows: they come out of repercussions within the small community of imaginative men. Mies starts it with an idea of loft buildings; a commercial company starts it with blisters on planes; Architect Bogner starts it with an idea of multi-use corridors; an editor starts it with recognition of leaping land values and need to condense finger plans; his synthetizing idea that the "loft" plan would help is made into a working hypothesis by a brilliant all-around architectural genius; from there on top architects working regularly and practically in the school field develop it into part of civilization. And let's not forget a thousand other little component developments such as developments in electric light, in ventilation and acoustics. It takes a vast number of workers of all kinds to develop civilization.

But they get nowhere except for the free mind, the mind that picks up its ideas from *anywhere*, that asks "why, why, why" and—even more important—"why *not*?"

windows for lighting and ventilation, the partition need not be soundproof. That was our thinking then, but since the storage wall idea has come up, a fourth basic consideration may be added to these three.

Some of the first examples of functional partitions designed by the author and his architectural associates were the plywood partitions used in the Blackwell and Stillwater Schools. A visit to some of the California schools by Ernest J. Kump and John Lyon Reid had given us the courage to go to these light wood frame partitions instead of the conventional tile and plaster. These partitions had the advantage of being non-load-bearing and of being of a material in which thumbtacks could be used. But the teachers were reluctant to use the walls as tackboard, partly because they did not want to mar the plywood, but mostly because the wood was somewhat too hard.

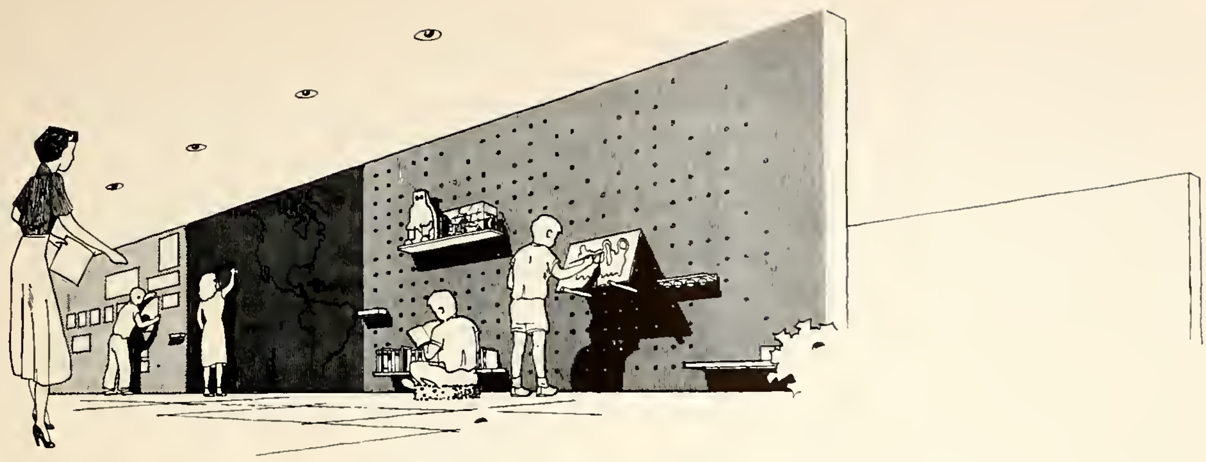
The next step in the development of a more functional classroom partition was the use of soft wood, vertical-board panels in the Port Arthur Schools. In close collaboration with Superintendent Z. T. Fortesque and his teachers, who wanted "very large tackboard area to put up the murals which the children develop for each unit of work," we decided that the best, most economical, and most beautiful material that we could use would be vertical hemlock boards. We made sample panels to see if thumbtacks would easily penetrate the wood before specifying the material. But even after the building was up and the teachers moved in, they were reluctant to stick thumbtacks in the beautiful paneling until we tacked up some material for them. During the planning stage, it was decided by conference of superintendent, teachers, and the architects that where chalkboards were used, they would be installed from floor to wall height, since the walls of the school were to be door height with glass above. The teachers thought this scheme (one used by Architect Alonzo Harriman of Maine) was excellent because in small group teaching they could use the chalkboards while remaining seated. They thought, too, that the larger chalkboards would allow more possibilities in chalkboard demonstrations, such as drawing large maps.

The next step was taken at the suggestion of Superintendent W. Gerald Barber, who worked very closely with us during the planning stages of a junior high school for Electra, Texas. "Let's make all of the walls either corkboard or chalkboard," Mr. Barber suggested. At first the idea seemed overly expensive, but after a careful examination of the cost factor, it was decided that the scheme had great merits and had a good chance to come within the budget. It was reasoned that since both corkboard and chalkboard could be obtained with a plywood backing, and since both could be secured directly to the studs, there would be a saving in the cost of a separate wall backing, as well as in the cost of a wall finish. The bids came within the budget, and the school is now under construction.

These developments towards achieving a functional partition led to still another possibility. For want of a better name, the architects refer to it as the "teaching space divider," because it is not a partition in the sense of a wall to form one side of a classroom. It is more of a teaching device, and bears closer relation to teaching furniture than it does to a partition. The approach to the design of this unit was made over a long period of time—about three years. Toward the end of that period, the author and his architectural partners were given the assignment of designing Laredo's new schools. It was their good fortune to have the opportunity of working with a live-wire superintendent by the name of J. William Nixon, another school administrator who believes in bringing in his supervisors and teachers on building problems. The architects had many sessions with Nixon and his staff, and among some of the items discussed was the need for special shelving and equipment for setting up demonstration material and holding reference books for unit projects. The group talked about the trouble the teachers were having with the easels' taking up so much space in the classroom. They talked about their problems of displaying large cardboard sheets of visual material. It was agreed that every square foot of wall surface was needed for teaching by some of the teachers. To make a long story short, here is what came out of all of this:

The architects devised the so-called teaching space divider. A full size mock-up was made and tested in the author's house by his most active, not so gentle, 9-year-old-daughter. It stood the test. The characteristics and functions of the teaching space divider are these:

1. It serves as a screen between classes, as does the ordinary partition.
2. It is built up of 4-foot panels which are prefabricated and which are easily demountable.
3. The design of the panels is such that they can be installed in the building after the building is completed, just like furniture and equipment.
4. At least two of the 4-foot panels have surfaces of perforated cement-asbestos board. By the use of ordinary golf tees, cardboard sheets and charts of all sizes as well as other visual materials may be secured to the wall without damaging any of these visual aids with thumbtack holes. Refer to the left-end of the illustrative sketch.
5. There are at least two panels with chalkboards from top to bottom. This vertical expansion of the usual 3-ft. horizontal strip provides two additional features; (1) it allows the drawing of large maps and diagrams, and (2) it allows the teacher to write at the chalkboard when she is seated instructing a small group circle. Refer to the two panels in the center.
6. The teaching space divider has one type of



175. The teaching space dividers have two great functions: (1) to allow for innumerable ways of subdividing spaces efficiently and economically, and (2) to facilitate the educational program by making every square foot an effective vertical work surface and teaching device. The sketch shown here is based on the design for the recently constructed schools built in Laredo, Texas. The units shown here are installed in 4-ft. panels of three different types. The first five panels shown on the right consist of a flexible vertical work space, on which teachers and pupils can put up many teaching devices such as a multi-number of shelf arrangements and easels. In some ways it is like a large tinker-toy, and makes use of hardwood dowels and specially designed shelving, drawing boards and trays. This unit was developed in the office of Caudill, Rowlett, Scott and Associates. The next two panels shown in the sketch consist of chalkboard. And the last panels are made up of perforated cement asbestos ceiling tile on which large cardboard sheets of visual aid material may be secured without marring the sheets through the use of ordinary golf tees that fit into the perforations. All of these units are prefabricated and demountable.

panel on which the teacher can make shelves the size and location of her choice. In some respects it works like a large "tinker toy." Approximately every four inches there are holes for hardwood dowels. By placing dowels in various positions in the wall the teacher constructs brackets on which shelving boards may be placed. The illustration shows one shelf on which the commonly used stuffed owl and aquarium rest for nature study. Underneath are the nature study reference books.

7. The teaching space divider also provides for easels by the insertion of two special dowels (the same as the others except for a cap on the end) on which a small drawing board is set. Paints are contained in glass cups on wood trays which fit into slot holes. See boy standing at right side of sketch.

Every square foot of the teaching space divider has educational use. It provides maximum vertical working surface. But this is only one way. The account of the planning of this unit has been included here because of the approach as well as the solution which came about from such planning. Some of the readers obviously will question the cost of such a seemingly elaborate setup. For the benefit of those readers, it should be said that the cost of the units in a 40-classroom contract ran less than 4 per cent of the total cost of the building construction.

The conclusions which might be drawn from the preceding discussion could be these: The envelope of a schoolhouse, because of the space requirements to carry on the various activities, necessarily must be subdivided. The location of the space dividers depends on the general activity of the school; thus we have spaces for class instruction, spaces for indoor physical activities, spaces for eating, and so on. Just how these space dividers are designed will depend also on the activities which go on within the spaces. Since the space dividers are vertical planes, they should be considered vertical working surfaces, as well as mere screens. The space dividers, therefore, have two major functions: (1) to serve as screens to separate the various activities and class groups, and (2) to provide vertical working surfaces for the class groups.

UNUSABLE SPACE MADE USABLE FOR EDUCATIONAL PURPOSES

We have seen first how corridors and then how walls have been made to serve education; even such spaces as boiler rooms and kitchens can be so utilized. It has already been mentioned in this book that the school plant offers great possibilities to the pupil who wishes to study the appreciation of architecture—the environmental art. Dr. N. L. Engelhardt Sr. spells this out more specifically in the following account:

> For many years, I have been advancing the thesis that several of the most complete and most expen-

sive educational facilities in school buildings were not being utilized for instructional purposes. Included among these are the boiler plant, the ventilation installations, the kitchen, the plumbing and waste systems, the interior decor of the building, the architectural design, the electrical and lighting plan, and the land use of the site. Of course, it must be acknowledged that alert faculty members in many schools sensed the possibility of using some of these facilities in advancing their educational programs, much to the intellectual interest and gain of their pupils.

The curriculum requirements of many school systems take students far beyond the confines of the school grounds. Elementary school children visit the firehall, the post-office and the market place in many communities. Students of higher grades inspect dam sites, wheat fields, oil wells, factories and opera houses. The range of this 'off-campus' study is wide and, rightly so, is becoming even wider through extensive use of school transportation facilities. The distant places are always alluring.

Frequently, the grass, however, is just as green in the home pastures. The educator and the architect can, to advantage, pool their thinking to determine how school buildings may be planned so that the most complete educational return can be secured from the great investments made in school buildings themselves.

The children in elementary classes may visit the distant grocery store where food is sold, but may never have the opportunity of inspecting their cafeteria's kitchen, where food is stored and prepared for their meals. They may visit the firehall of the neighborhood to see smart-looking fire-engines designed to put out fires, but may never be introduced to the fire-extinguishers, the sprinkler system, the panic bolts, the red exit lights, the fire-resistive waste containers, the fire-alarm system and the other planned measures intended to make a fire-engine's emergency visit to the school unnecessary.

The Board of Education is induced to provide an extensively equipped physics laboratory, where, inter alia, heat and electricity are taught and yet neither faculty nor students may be introduced into the mysteries of the school's heating and electrical provisions which constitute the most expensive laboratories in the school building. The color scheme of the entire building and the architectural design may provide splendid subject matter for art instruction, which, however, may be supplanted with illustrations more remote and of less significance in the lives of boys and girls.

The fact is that instructional programs have definitely moved beyond the rectangular delineations of the traditional classroom and laboratory and are, in reality, no longer restricted by time and space, if I am to judge from contact with children of this modern era. The time is ripe for canvassing fully the educational possibilities of the immediate environment of the school, so that no possibilities of educational gain are ignored in the planning of new school facilities.

The old idea was that a school building was planned with compartments in which instruction was given 'Mark Hopkins on a Log' fashion. What I am seaching for is a way to plan school facilities so that every feature arouses intellectual curiosity and stimulates educational growth. Thus faculty and students, engineers and administrators become immersed in an environment which teems with educational interest.

One of the best examples of this, that I know of, is the heating plant, planned by John Lyon Reid in a Martinez, California, elementary school. (Case Study 2.) The plant is at the corner of the busiest intersecting corridors of the school. Its walls are of glass, the equipment within glows with shining brass and attention-drawing colors. The youngsters stand and gaze. They tell each other about what they see and no doubt many a classroom discussion results in a group inspection of the plant. Spelling can be centered around this experience, compositions can be written, and further discussions can be had. This is a wonderful way to learn. Every feature of the school building can, in a similar way, be made to appeal to eager young folks.

Dr. Engelhardt continues:

In New York City, during my service as Associate Superintendent of Schools in charge of school building planning, Architects Starrett and Van Vleck and I planned the boiler room of the William Grady Technical High School with glass walls overlooking the boilers and stokers and a spectators' gallery encased in glass which might be used as the class area for student instruction and discussion. Similarly, a study and discussion corridor was planned to give a view over the entire kitchen. From this vantage point, with the instructor using a peripatetic microphone, the details of kitchen layout, its sanitary specifications, the storage of foodstuffs, the preparation of meals, the service of meals and the removal of waste could be the basis for many hours of fruitful instruction. The city health regulations would not permit any classes or observers to move through the kitchen itself.

This very stimulating statement by Dr. Engelhardt is nearly a philosophy within itself. If school planners will grasp its significance, we will have better schools. Putting glass in a wall of a boiler room is not so important because that is a solution. But putting it there because of the educational value to children is very important, because this is the child-centered idea which is essential in the approach. When school planners can somehow grasp the real purpose of the building—that more than being mere structural shell, it exists to serve the children educationally, physiologically, and psychologically—then we shall start getting schoolhouses that are more than mere storehouses for children.

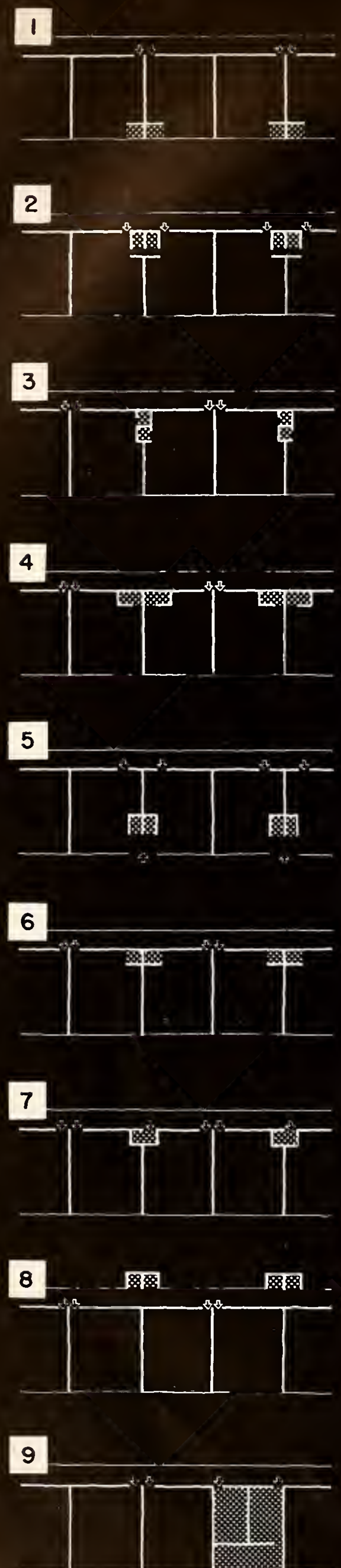
LOCATION OF TOILETS WITHIN THE SCHOOL PLANT

These past 10 years have brought as much of a change to the planning of toilets in the elementary school as they have to any other space element. Before that time it was a real achievement to get toilets on the inside of the school instead of located in shacks at two corners of the site. When at last they were brought inside, these outside toilets were first put way down in the basement, and we still have hundreds of schools in the U. S. with the toilets located in dark, inconvenient basements. Then after another long period things began to pick up for school youngsters, and the toilets were brought upstairs and placed at each end of the corridor, one end for the boys and one for the girls. Then about ten years ago someone decided that perhaps a better way would be to have the toilet facilities adjacent to each classroom, "just like we have at home." And most school planners agree to this premise, but they disagree as to how far through the grades it should go. Some think it concerns only the kindergarten. Others are convinced that classrooms up through the 6th grade should have individual toilets for each classroom. The author knows of no school planner advocating individual toilets in grades above the sixth, but he takes note, that some of the airliners, instead of having two individual small toilets, one for women and one for men, have two for either with increased efficiency.

School administrators and teachers do not object to the classroom toilet set-up nearly so much as do the school board members. Many architects have found this so when their preliminary plans show individual toilets for each classroom. Where objections are too great, the first compromise which these objectors usually present is something like this, "Well, the parents won't like their little girls going into the same room used by the boys, so let's make a separate toilet room for each sex, but use this arrangement only in the first grade." Of course, these little first year kiddies do not care who was in the room before, or whether the person was wearing a skirt or pants. Generally what happens in the next building program where this same objector was involved is something like this, "Well, the classroom toilet deal seems to be working out all right, let's save some cost and put in single classroom toilet units and extend them through the third grade." But why stop at the third grade? "Well, that is about the time these youngsters start noticing things." At this writing it seems that the large majority of school planners, with a heavy backing of the school board members, think that individual toilets work satisfactorily and should be recommended—up to the third grade.

Harold Silverthorn, Consultant on School Plant Planning, who has the imagination and idealistic vision of the architect and the training and practical application of the school administrator, takes the stand that individual classroom toilets should be used up through the sixth grade; and he has evidence to prove it. Silverthorn's argument is presented in his own words, based on his experience in the Office of the Superintendent of Public Instruction, State of Washington:

> Educators throughout the state have become increasingly critical of the large banks of toilets that have been designed into the toilet rooms in the school buildings in the State of Washington. Administrators, teachers, and custodians are particularly critical of the large toilet rooms where the children are not supervised and where damage to the plumbing fixtures and walls occurs. Teachers are particularly concerned about the children's not washing their hands after using the facilities, and that there was no arrangement in the classroom to enable them to supervise the handwashing in the classroom. Many educators are particularly perturbed about the tendency of a few classroom teachers lining up their youngsters and taking the entire group to the toilet room before recess and the lunch period. It is the consensus of educators that there should not be a mass migration of the classroom population to the toilet rooms at specific times, that these facilities should be conveniently located so that the children can use the toilet facility at the time they need to and not at any specified time.
>
> As teachers, principals, custodians and children were brought into the planning of school building facilities, this particular problem was recognized. Consequently when educational specifications and ideas of the teachers were brought in for the architects to design facilities to fit the educational program and to improve the comfort and well-being of the occupants of the building, more stress was placed on the fact that toilet rooms should be located in or adjacent to the classroom. It was pointed out by teachers who have classroom toilets through the sixth grade that there is no embarrassment on the part of the children to use toilet facilities adjacent to the classroom. Many teachers insist that each classroom should have a wash basin to enable the teacher to supervise the washing of the child's hands after he had used the toilet. After the statement of ideas of the teachers and others were presented to the architects, they worked on different schemes to carry out the proposed suggestions of the teachers. The designers have come up with many different schemes for these facilities. (Note: some of these schemes are presented in the illustration on page 72). However, we could find at least a dozen more that are variations of these. Of the nearly 270 elementary projects that have been designed or built during the past year, nearly 50 per cent of the complete elementary units have used the individual classroom toilet arrangement.
>
> Our studies of school building design with individual classroom toilet facilities indicate that about 400 sq. ft. is used in an 18-classroom building for toilet space. However, in the schools where there are banks of toilets, an 18-classroom building will use



Placement of School Toilets

176. Here are some arrangements of toilet facilities suggested by educational consultant Harold Silverthorn. These are only a few of many solutions.

> approximately 2,000 sq. ft. of interior floor space to house the large toilet rooms. In situations where we have taken alternate bids and made comparisons between the cost of banks of toilet rooms and individual toilet rooms, there is every indication that the plumbing and fixtures cost considerably less than when they are installed in the large toilet rooms. So there is economy in installation and also a significant saving in square footage in the building that is used for toilet rooms.
>
> Where the individual classroom toilets have been used, ceramic tile is often not specified on the floors, nor have they used glazed tiled block on the walls. Usually it is entirely satisfactory to use asphalt tile on the floor, with plaster or block walls. In the large banks of toilets, because of the vandalism that occurs due to lack of supervision, it has been found that it is absolutely essential to use ceramic tile on the floor with glazed tile block on the walls. Unquestionably, installation of this material increases the cost of the total building.

Such a statement by Harold Silverthorn makes good sense. Toilets should be placed where they can be most easily supervised and are the most convenient for the pupil, and that is the way Silverthorn has recommended them to be.

Whether or not individual toilets will work in the secondary schools is another matter. Certainly laboratories such as shops, agricultural units, and home-making units should have individual toilets. Perkins and Cocking[45] say that there is a growing tendency away from the large group toilets in high schools because of serious discipline problems, and that new schools now have more, but smaller toilet rooms. Maybe this trend will someday approach what we now think is desirable in the elementary school.

SPACE FOR DINING

What kind of an atmosphere should the children eat in? There it is, the question so simple and basic that practically no school planners, apparently, ever get around to considering it, for the eating arrangements in almost every school today are just plain terrible. The entire dining problem needs a fresh solution. To obtain the solution there must be a fresh approach, and the best starting point is to answer the simple and basic question.

What is the best way to have school children eat? Is what is now being done really desirable? Is it right to herd children into a large, noisy chamber, make them wait in line while others eat, and then, after they

finally have obtained their food, have them sit down and eat while seeing others waiting to go through the same process? Would not stimulating, quiet, home-like conditions be better? There are many people who believe that there has been less advancement made in the design of dining places in schoolhouses during these last few years than in any phase of schoolhouse design. The same people believe that architects have done a better job of designing taverns and bar-rooms than they have of planning school cafeterias; at least these architects recognize the social aspects of eating and provide quiet nooks in such places so that the people can dine and drink in a quiet atmosphere. They have eliminated from adult eating places the boiler factory din found in the ordinary school cafeteria, the noisiest element of the entire school plant. Perhaps the reason why school staffs usually prefer to eat in a separate dining hall is that they cannot stand the noise. But what about the children?

Even worse than the cafeteria is the all-purpose room which serves not only as a place to eat but as an auditorium and a gymnasium as well. For other combinations refer to Case Studies 42 and 67. As everyone knows, a gymnasium simply is not a desirable place in which to eat because of its odors and acoustics. In addition a gymnasium is not intimate; and high ceilings certainly are not conducive to table-talk. There is probably no one who really knows just what conditions are the best for eating, but it seems as though the atmosphere of the home might be as good as any.

Is it possible to capture the atmosphere of the home in the schoolhouse? Quite possible. A tremendous advance has been made in the design of homelike classrooms for elementary schools. During recent years the architects have been highly successful in helping to span the gap between the home and the school by producing a homelike atmosphere in the school. There is no reason this same atmosphere could not be carried into eating spaces within the schools. Even the simple method of dividing large dining areas into smaller ones would help tremendously in achieving the homelike feeling. Perhaps school architects should borrow ideas from architects who design restaurants. In the design of large eating establishments many dining spaces are provided, not just one large one; as a result, acoustical problems are eliminated, and diners enjoy a more intimate atmosphere. In applying this principle to schools there is much to be said for eating in classrooms.

Most educators agree that the school lunch program must be coordinated with the total school program; health habits, nutrition benefits, manners, study of foods, all tie in with eating (Case Study 5). If the subject can be brought into the classroom, why not the food itself?

But is not eating in the classroom messy and unsanitary? We eat in living-dining areas in our homes; maybe that is enough of an answer. Most of the readers are, no doubt, frowning at the idea, and so did the author when he first heard of it. But when he experienced it, his attitude changed. While participating in a school planning conference at Yakima, Washington—one of the many sponsored by the great woman educator, Pearl A. Wanamaker—the author had the opportunity of eating in a school (located just outside of Yakima) where the lunch program was carried on in the individual classrooms. An account of this must be included here because the idea may have tremendous implications for school planning. Think of the thousands of dollars that go into the construction and management of cafeterias (and school kitchens) which might be saved if lunch programs could be carried out effectively in the classroom space!

Both Wallie Scott (my architectural partner) and I were skeptical when told about this dining setup, but we were invited to see for ourselves how it worked. It was about noon when we reached the school, and one or two classrooms had already been served. We joined one of the third grade classes. The class was all prepared for lunch. The teacher had finished describing the menu of the day and its nutrition value. Each pupil had washed his hands and combed his hair, since a convenient lavatory and mirror had been provided in the classroom. John and Frosty had already been sent to the school's refrigerator (incidentally the only sign of kitchen facilities at the school) down the corridor to pick up the trays of milk, of which they had calculated the number. A cute little girl by the name of Kitty was ready to pass out the napkins. By the time the boys got back, three ladies and a food cart had arrived at the classroom door, and lunch was ready. In cafeteria style the class got their hot food and went back to the tables, which had previously been cleaned for dining. There was no rush, no tension. The boys and girls seemed relaxed, and they went about their eating in a most natural, homelike setting. After lunch was over the food cart returned to pick up the trays and dirty dishes. It was certainly an eye-opener for Scott and me. We thought that though this might not be the final answer to the dining problem, at least it showed that the conventional cafeteria might not be either. We inquired more about how the system worked. We were told that the school had no cooking facilities and that the food was all cooked at a central kitchen at the high school and brought to this school, as well as to other elementary schools, in an ordinary pick-up truck. The food was carried in thermo-cans. For another central cooking setup, refer to Case Study 68, and for another classroom eating setup refer to Case Study 53.

Probably the reason that school districts have gone in for the idea of central kitchens has been that there is every evidence that it is far more economical in the use of kitchen help, but also there is great economy as far as capital outlay is concerned. Harold Silverthorn, whose broad experience has included as many as 25

school districts that are using central kitchens, is again called upon to present evidence of this fact. He has this to say: "We have had a recent breakdown of cost on kitchen help in two school districts—one that has central cooking, and the other that prepares the food in the school buildings. This sampling indicated that only 10 per cent of the labor required to prepare the food in the individual school kitchens was needed for central food service." His argument that the capital outlay, too, is cut by the use of a central kitchen is based on the theory that as the number of pupils to be served is increased, the amount of equipment necessary is not increased proportionately, but at a much lower rate. Silverthorn also says: "At the present time we have about 200 school buildings in the State of Washington that are serving meals to the children in the classroom. This is about 100 more than were using this method last year." Surely this is a trend, and unquestionably it will have national significance. Already the central kitchen idea has taken strong hold in California, and it has been used to a more limited extent in other states.

Both the central kitchen idea and the classroom eating idea give great impetus to the open plan concept. Like the food which is served in the airliners, the school lunch may be carried to any place within the school plant. Lounges off the corridors would make excellent dining spaces. Outdoor terraces, too, have great possibilities (See Case Study 5). It stands to reason that any place that the family can have a buffet supper is the sort of place that could be used for the school lunch. Of course there are administrative problems as well as educational ones, and the success of eating informally would depend on eating in a family group. But is not the elementary class a family in one sense? Is not the high school homeroom a family, too? In any event, school planners and school administrators should open their eyes to these possibilities, because if informal dining and central kitchens are feasible, the architect will have a better opportunity to make the school a pleasant place for youth to work and play, and by eliminating cafeterias and individual kitchens he can save money as well. One last thought: Adults enjoy eating with one another; they seek quiet intimate places to enjoy a good meal. So do children.

SPACE FOR ASSEMBLIES

Certain aims of education require pupils to meet sometimes in large groups. As the pupil grows older and becomes more advanced in his musical, forensic, and dramatic skills, he needs the opportunity to express himself and display his talents to a sympathetic audience. Usually an audience of his own age is the most appreciative (except for his parents). His fellow students by seeing him perform also pick up certain knowledge and appreciation for his art. That is one of the reasons assemblies are included in the school program, and probably the most important one which affects the design of assembly areas. And this discussion of assembly space will start from this reason.

Assembly space, therefore, is designed (1) to accommodate a performer, and (2) to accommodate an audience. Even in many commercial theaters and concert halls it is hard to give a performance of any kind without having to sing very loudly, to talk above the natural speech level, or to play an instrument fortissimo. Both audience and performer are under strain, and there is little scope for accent or expression. Unfortunately most school auditoriums have all the bad characteristics of the legitimate theater and none of the good ones. The excellent lighting and scene-shifting equipment of the theater is never found in the school, but school auditorium seats are as crowded and uncomfortable as any on Broadway. In addition, since auditoriums are larger than theaters and since children cannot project their voices as do trained adults, student performers find it even more difficult than professionals to make themselves heard. Seeing as well as hearing is a problem for the audience, for school auditoriums usually have a great number of seats behind obstructions or placed at difficult angles in relation to the stage.

This brings us to the discussion of size of assembly areas. What is the optimum size? Can they become too large? Can they become too small? Of course there are uses for the very large auditorium or assembly hall as well as the very small. But the trend today seems to be away from the large auditorium, and for good reasons. One that has already been mentioned is the simple fact that school children have difficulty in projecting their voices into large spaces regardless of how good the acoustics are. Another is that even the best acoustics engineers have trouble in designing spaces to seat over 1200 people. Of course there are some examples of auditoriums having seating capacities over 1200 being acoustically correct, but these are the exception, not the rule. But the main reason for having small auditoriums in school plants stems from education.

First consider the elementary school, a much smaller unit, generally, than the high school. Should the assembly unit be sized to house the entire student body? From the standpoint of education, no. There is a great intellectual difference between the first grader and the sixth grader, as well as social differences, and the assembly program planned for the first grader generally does not appeal to the sixth grader, and so on. These factors, of course, help to determine the size of assembly areas in the elementary school.

These same factors should apply to the secondary level, and apparently they do. Engelhardt, Engelhardt, and Leggett[48] say that auditoriums seating from 600 to 800 pupils are increasingly favored among the school people. But what about the night of the Junior or Senior Play? If we are really thinking about the pupils (who are in this case the performers), first we would want the small auditorium because the student per-

Let the Audience See and Hear

177-180. Spaces designed for large group participation, such as school assemblies, have two great functions: (1) to see and (2) to hear. The traditional high school auditorium with its flat floors and large windows does neither well. The first three photographs shown here are auditoriums scientifically designed for proper seeing and sound conditioning. The bottom photograph suggests that not all assemblies need to be carried on indoors; in fact, there are many occasions where outdoor assemblies are desirable. Again, here is a case where the economical outdoors is used for effective learning activities.

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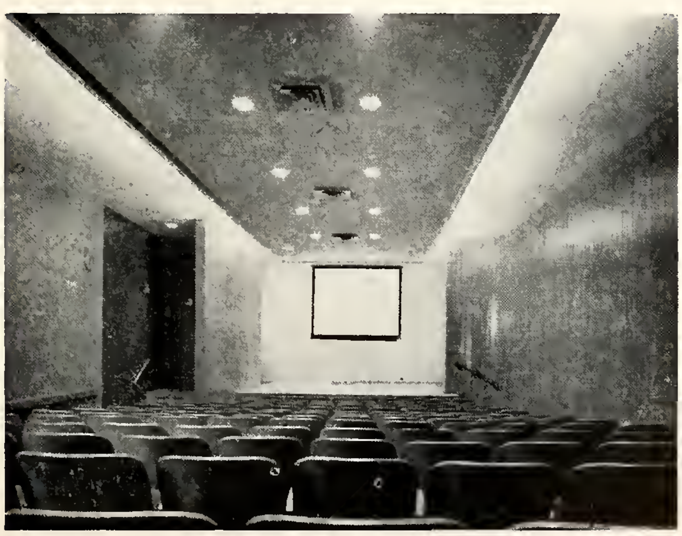

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former has a better chance of doing a good job in these small auditoriums, and secondly we would prefer many performances instead of one because each one has its educational value. If a high school senior boy played Sir Benjamin Backbite in "The School for Scandal" three times instead of one, he certainly would benefit by each performance. For that matter if there were three entire casts instead of one, the educational value would be greater. That in itself is a very strong point in favor of small auditoriums. Another good reason is that for proper hearing conditions, authorities recommend that the last seat be not greater than 75 ft. from the speaker (others go up to 100). That puts a limit on the seating area in one direction. The relatively narrow angle of vision for movies and slide lectures puts a limit on the seating area in the other direction.

Now what about fixed seats? Are they feasible in school auditoriums? By all means. If properly arranged on a sloping floor they assure good seeing conditions because they are fixed. Planners of movie houses and theaters have taught us that. It is always a good plan, however, to have an area adjacent to the stage for movable seats to allow for the large number of performers who are in bands, glee clubs, and commencements. Now what about windows? Should we have them or not? From the standpoint of acoustics, they are no good. Certainly they are not needed for lighting because daylight is unwanted in auditoriums under most conditions; there are more permanent blackout curtains put in the school auditoriums than any other places. It costs much less money to construct solid walls than it does to build them with windows, then cover up the windows with expensive draperies. But what about ventilation? The windows do no good if they must be covered up, so mechanical ventilation is necessary anyway. This brings to focus the three main things the audience wants in an auditorium: (1) to see, (2) to hear, (3) to be comfortable. For an auditorium that functions for the audience accordingly, refer to Case Study 36.

Perkins and Cocking[45] summarize the characteristics of a good auditorium, and their account will serve as a summary for this discussion:

1. The room should be narrow because of sight lines and movies, but should not go beyond the limits of good hearing conditions.
2. The room should be windowless for controlled lighting.
3. There should be fixed seats except for an area of removable seats at the front of the room which can make the stage expandible for group performers, such as glee clubs.
4. The stage should have a place to handle scenery at the side and a place to pass across at the back; the stage and proscenium should be scaled to the scene-making ability of the students.
5. The walls, ceiling, and floors should be angled to implement acoustics.

They add one more thing—that the room should be beautiful, and that beauty need not be achieved by pasted-on ornaments.

WHAT ABOUT THE STAGE?

Other faults of auditoriums today are the stages. Unfortunately, most of them are just miniature copies of Broadway prototypes, designed for only a few performers. But when schools give performances sometimes as many as 300 pupils participate. The up-to-date school stage will have the flexibility to take care of such a large group as well as the small group. It is unfortunate, too, that most of the stages today are the results of halfway attempts to copy the conventional flylofts. If the excessive space required for those things could be spent for stage floor space, a more functional stage would result. In order to take care of the large performing group, some newer auditoriums have been designed which have multi-use stages that serve theater-in-the-round program, during functions like graduation and other functions in which the size of the stage can be limited. For a Case Study which approaches the stage design with directness and freshness, refer to 84.

STORAGE SPACE EQUIPMENT AND MATERIALS

One would never think of buying a car without looking under the hood to see if it is fully equipped. But some school board members have purchased classrooms without any equipment whatsoever, with only the bare walls with a few feet of chalkboard stuck to them. Then they brag, "What a bargain we got. Our school only cost such and such a square foot, two bucks cheaper than what Jonesville got." If they had purchased a car and found it without an engine, they would not have been so cheerful, regardless of what they paid for the thing. A school without space for the storing of equipment so necessary for teaching as projectors, globes, maps and models and without space for storing reference books and work materials simply is not designed for education. It may look good to some people from the outside, but to the teachers and students who must use it from the inside, the school is like a fishing line and pole without a hook, like a desk without drawers, or a house without closets. Storage facilities are essentials, not accessories. Classrooms and laboratories are like kitchens; they have to have storage cabinets, closets, and work areas. And the planners of these units must know how much storage is needed, what kind, and the relationship of the storage units to the various work areas and to other storage units before they can arrive at any functional space arrangement. Yet every day throughout the U. S. we still continue to build classrooms having only the four bare walls. But things are looking up;

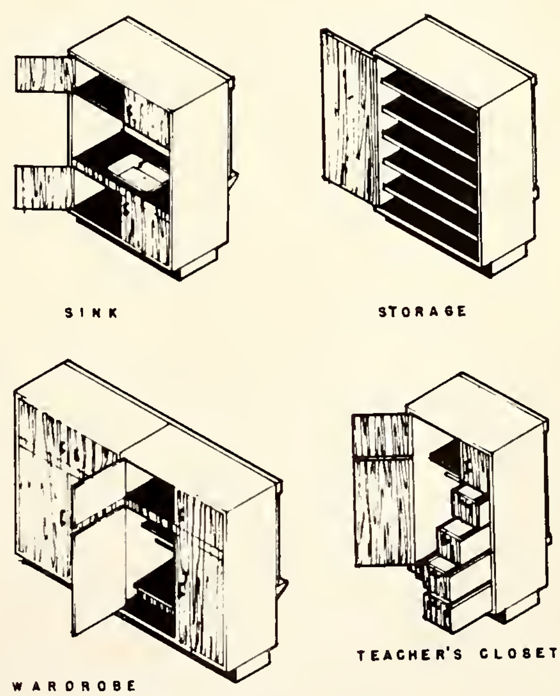
more and more, classrooms are becoming better equipped for teaching. In a few years the bare-walled cells may be gone forever.

Of course we can go to the other extreme, and the author has been guilty of it. He has designed classrooms and equipped them with what he thought were ideal storage facilities; then two years after the teachers and students have moved in, he has been shocked to find that some of the cabinets contained just junk like old boxes, damaged models made by students, soiled art work, and even dried-up Christmas trees! Storage facilities cost a lot of money. They can raise the cost of the school as much as 30 or 40 per cent. A good classroom or laboratory will have just enough storage to carry out an effective program—not too little, not too much.

Where should cabinets and closets be located? There are not any set rules; it depends so much on the circulation within the room and on its shape and size. Case Study 29, the storage wall scheme, shows them used as partitions between the classrooms, a very effective location. A great number of new classrooms have storage units on the exterior wall below the window sill with the heating units behind them. The author and his associates developed a free-standing storage unit called the Teaching Center which also served as a demonstration unit for the teacher (See Case Study 91). Most school planners make use of the low storage units for horizontal work surfaces. And the school planners have agreed that there should be both open storage units and those with doors. It is a very difficult job to design each of these storage units to be an integral part of the classroom and laboratory composition. So often consideration has been given only to utility, and the resultant rooms take on the atmosphere of disorder and ugliness; only highly skilled architectural composers have experienced the success of storage integration which gives unity and beauty.

Within the last two years the movable storage unit has become very popular, particularly on the West Coast. Leaders of this movement are Architects Kenneth G. Branch of Washington and Henry L. Wright of California, together with Educator Russell Wilson of Michigan. Educators R. R. Russell and Z. T. Fortesque and the author also had a hand in getting the movement started in Oklahoma and Texas area. The advocates of movable cabinets say that when storage units and work space areas are "built-in," the classroom lacks versatility. They say that because of the individual desires and teaching methods of the various teachers, no two classrooms should be alike. The movable cabinet units allow the teacher to make his own arrangement, to fit his own specific needs of teaching. Usually these cabinets are modular in design, so that they fit together with a certain amount of unity, and are also adaptable for grouping around the perimeter of the classroom. They are often designed as free-standing units with chalkboard or tackboard for backs, so that the teachers can use them as space dividers within the classroom. The advocates of these movable units claim that they are economical because they can be built and finished in the mill, not on the job, where limited power equipment, the possibility of bad weather, and expensive finishing labor are great disadvantages. The idea sounds like a good one, and it is. But apparently a certain amount of teacher training is needed along with the development and perfection of these units.

This is brought out in an incident that Superintendent R. R. Russell of Stillwater, Oklahoma, and the author experienced in the first scheme of movable units to be used in this area. Russell, Architect Philip A. Wilber, the writer, and his associates decided to use movable classroom units in one experimental room of the proposed Will Rogers Elementary School. After a great deal of study to arrive at the design of each unit and to determine the module which would allow the greatest number of classroom arrangements, they finally found a scheme which could provide many variations. But after the building was constructed and the teachers and pupils move in, the teacher who was assigned to this experimental room arranged the movable units to "look like" what the other teachers had. She



Storage Possibilities: Wall Units

181-184. Here are some storage wall units developed in the office of McLeod and Ferrara, Architects. Such storage units serve as partitions and have the advantage of other movable units plus a more sound transmission reduction quality. For further details refer to Case Study 29.

simply did not understand the full possibilities. But with a teacher training program the units can be highly successful. And they have been.

Branch in Washington, Wright in California, and Wilson in Michigan experienced success from the very start. Russell now has the situation well in hand, and Fortesque in Port Arthur, Texas, has two large elementary schools complete with these movable units and working satisfactory. Apparently movable units are here to stay. For some of Branch's units refer to Case Study 50. Russell Wilson explains his units in his fine book *Flexible Classrooms*.[51] The illustrations shown here are sketches of the units developed by Henry L. Wright and his associates. Note the kinds of storage units which are movable: pupils' wardrobe units, pupils' cubicles for storing books and materials, easel and storage units, saw benches, teacher's wardrobe and general storage, clay storage and cart, block and material storage unit, file and storage case, low bookcase, high book case, and general storage unit.

STORAGE SPACE FOR WRAPS AND PUPILS' BELONGINGS

Storage for wraps appears to be one of the most important problems and deserves analysis. Generally it can be broken down like this:

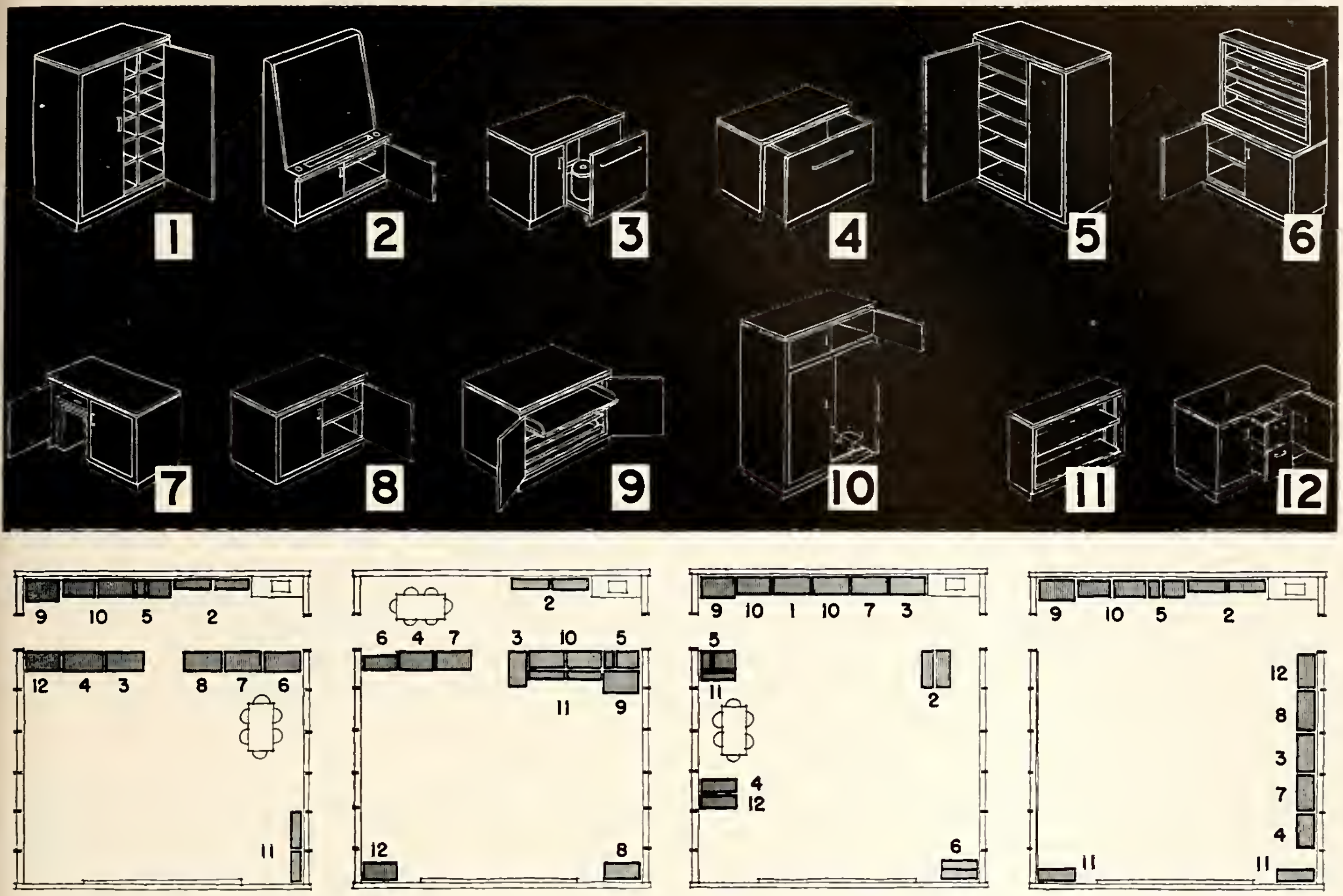
1. The pupil needs a place to hang wraps, which may include a sweater or overcoat, cap or hat, and occasionally a raincoat and overshoes or boots, some of which may be wet or muddy.
2. The pupil needs a place to store his text books, personal writing materials and notebooks, pencils, and so on.
3. He sometimes needs to store gym clothes and shoes.
4. Quite often he needs to store for safe-keeping such items as money, watches, and personal belongings.

That just about describes the needs which the so-called locker attempts to meet. But must the locker fulfill all of these functions? Why can they not be separated? Apparently the locker has been designed for protection —to put all of these things under lock and key. But *must* they be put under lock and key? There is no doubt that there are some situations in which lock and keys are necessary, but the writer believes that in hundreds of cases the lock and key idea has been retained because of convention, not necessity. Two different cases substantiate this. The first came about during the remodeling of an old high school building in Albany, Texas. The old building had the conventional steel lockers lined up against the customary interior corridor. During the planning stage Roy Hathaway, the Superintendent Schools, said to the author, "Bill, why can't we get rid of these noisy lockers? They are not only a noise nuisance, but their maintenance is tremendous. The doors get bent and the locks come off." He was asked what he wanted in place of them. He said, "I have a hunch we can get by with large pigeon holes, just big enough to put their books in." "No doors?" He replied that thefts were very rare. "But what about the coats?" His reply was a suggestion that we merely put hooks underneath the individual cubicles. We talked over his scheme with some of his teachers as well as some of the high school children. And out went the traditional lockers! The children loved the results. Of course, some kidded about "the hens' nests," but the scheme has worked very satisfactorily. The cubicle scheme was economical; it made the corridors much more attractive, and the doorless units reduced noise levels tremendously.

The other case concerns the Norman High School. The author noticed during the programming period of the planning of this school that the pupils in the old high school rarely closed their steel locker doors. Because the storage space was cramped, they hung their wraps on the door. Although this was very unsightly, it was also very enlightening. Why have the doors in the first place if they are to be used as coat hooks? Don Garrison, the superintendent, immediately saw the significance of this, so the new school has clothes rods and coat-hangers to store the pupils' wraps as they are stored at home, and cubicles to hold their books.

Here is a list of some ways of storing wraps and belongings: (1) have pegs on classroom walls to hang wraps, with shelf above on which to put books; (2) have the same kind of arrangement in the corridors; (3) have lockers, wood or steel, in classrooms; (4) have steel lockers in corridor; (5) have clothes closets in classrooms for wraps and cubicles for books; (6) have coat and hat racks in nooks off the main circulation space; (7) have cubicles for wraps in classrooms with shelf above for hats and books. Of course there are many more—some in which all of the functions mentioned are dealt with in one unit, some in which each function is taken care of by a separate unit, and some having various combinations.

There are many kinds of plan arrangements for these storage facilities. Let us look at some of them. Refer to illustration no. 186 on page 181. Sketch 1 shows these units on the corridor wall of the classroom. They could open out as in the conventional high school arrangement, or they could open in. There have been units designed for elementary school situations where the units open both into the classroom and into the corridor—a double-door arrangement. Sketch 2 shows an arrangement similar to Case Study 10 which provides for the units off the corridor. Sketch 3 shows the possibility of the movable storage unit advocated by Wright, Branch, and Wilson. Sketch 4 shows fixed units grouped around the classroom entrance, but off the corridor. Sketch 5 shows wraps stored on the outside wall of a corridor; a prime example is the Westwood Elementary School in Woodstock, Illinois, by Perkins and Will. Sketch 6



185. Here are sketches of some movable storage units developed by Architect Henry L. Wright and his associates. The sketches on the left above are used here as a legend for the four classroom arrangements shown below them. The exact arrangement will, of course, depend upon the desires of the teacher and the characteristics of her teaching program. This kind of flexible classroom arrangement cannot help but facilitate an activity program. The units are as follows: (1) students cubicles, (2) easel, (3) clay cart and storage, (4) block box, (5) teacher's wardrobe and general storage (6) high bookcase, (7) single saw benches and storage, (8) general storage, (9) paper storage, (10) student's wardrobe, (11) low bookcase, and (12) file and storage case.

is similar to Sketch 1 except for the double-loaded corridor situation. Sketch 7 provides for large alcoves for these storage units. Sketch 8 is the storage wall idea expressed in Case Study 29. Sketch 9 provides for outside storage for schools situated in mild climatic regions; this is very similar to the Laredo Junior High School arrangement. Sketch 10, like the Norman setup, has movable units in a student center arrangement.

The design of the pupil storage is a wonderful design problem within itself; the same approach advocated in this book should be applied also to solving the locker problem. The noisy, inadequately-sized steel locker apparently is not the perfect solution. Certainly not when students must hang their coats on open doors! If locks are not used, why should there be doors at all? The elimination of doors cuts down first cost and high maintenance, and helps to reduce the noise level, a very disturbing factor of most corridors. In order to improve this situation, there must be a complete re-examination of the problem. Let us not work from a solution, the so-called locker, let us work from the real problem. As a summary, apparently we have three things we must discover: (1) a good way to store wraps; (2) a good way to store books; and (3) a good way to take care of valuables.

Consider the first—to store wraps. A small locker does not do a good job; a much better method would be to use rods and coat hangers. Even the old time coat tree in the local barber shop does a better job than do small lockers, and so do the portable racks generally found in restaurants. If so, why do we not have these things in schools? Because we must put the wraps under lock and key? Experience shows that, in many places, we do not have to.

What about the second task—to store books? Is it really necessary to store books together with the wraps?

The books are used nearly every hour of the day; the wraps, only once or twice. Is it necessary to put books under lock and key? Perhaps there are places where such protection is necessary, but there are many more where it is not, particularly in states which have free textbooks.

And what about the storage of valuables? Money, of course, needs some protection. But most pupils, particularly those in high schools, carry their own purses and billfolds with them. And they usually carry expendable materials, such as tablets and pencils, with them too. Perhaps the problem of storing valuables is not so much of a problem after all. But if it is, would not it be better to use boxes with keys, similar to those found in post offices, instead of the conventional lockers? In Laredo, Texas, where the children do not wear extra wraps, the architects specified commercial liquor cabinets to be used as book storing units!

We have much to learn about storage places for wraps and personal belongings. It is a real problem, one that requires a fresh solution which must come from a fresh approach.

THE BROAD CONCEPT OF THE VARIOUS DIVISIONS OF SPACES

In one sense the school plant is a small community with its own little home, its own offices, its own theater, its own shops, and its own restaurant. The classrooms are, in essence, homes for the children, and some of them have their own yards and gardens. The administration unit is an office, pure and simple, no different from the local insurance office or the building-and-loan agency; the problems of circulation, storage, lighting, records, and privacy are essentially the same. The school cafeteria is no different from the ones downtown; it has the same problems of food storage, cooking, serving, and eating. The assembly unit of the school and the theater of the community are very similar; the problems of seeing, seating, and hearing are common to both. A school shop differs very little from ordinary shops found in every community. Underlying this very simple conception lies an unlimited reservoir of planning data which can be applied to the school plant.

Architect Henry L. Blatner, Consultant to the State of New York Commission of School Building, advocates extensive study of non-school building types for the purpose of improving schoolhouse planning. He says that the activity of teachers and children at school is duplicated daily by many people engaged in various pursuits of life. According to Blatner, the preparation, serving, and consumption of food is universal and may be found in the home, restaurant, store and factory, as well as in the school; storage of clothing and supplies is common to the housewife, storekeeper and teacher; and vocational methods and equipment are closely related to those of industry. If Blatner is right, and there are no reasons to believe he is not, then two things are evident:

(1) Architects who do schools should study other building types.
(2) Architects who have made great contributions in other building types should be encouraged to do school buildings.

If the various divisions of space are considered as non-school building types—like a home, an office, a theater, a library—perhaps planners may recapture a fresh approach to solving the total problem.

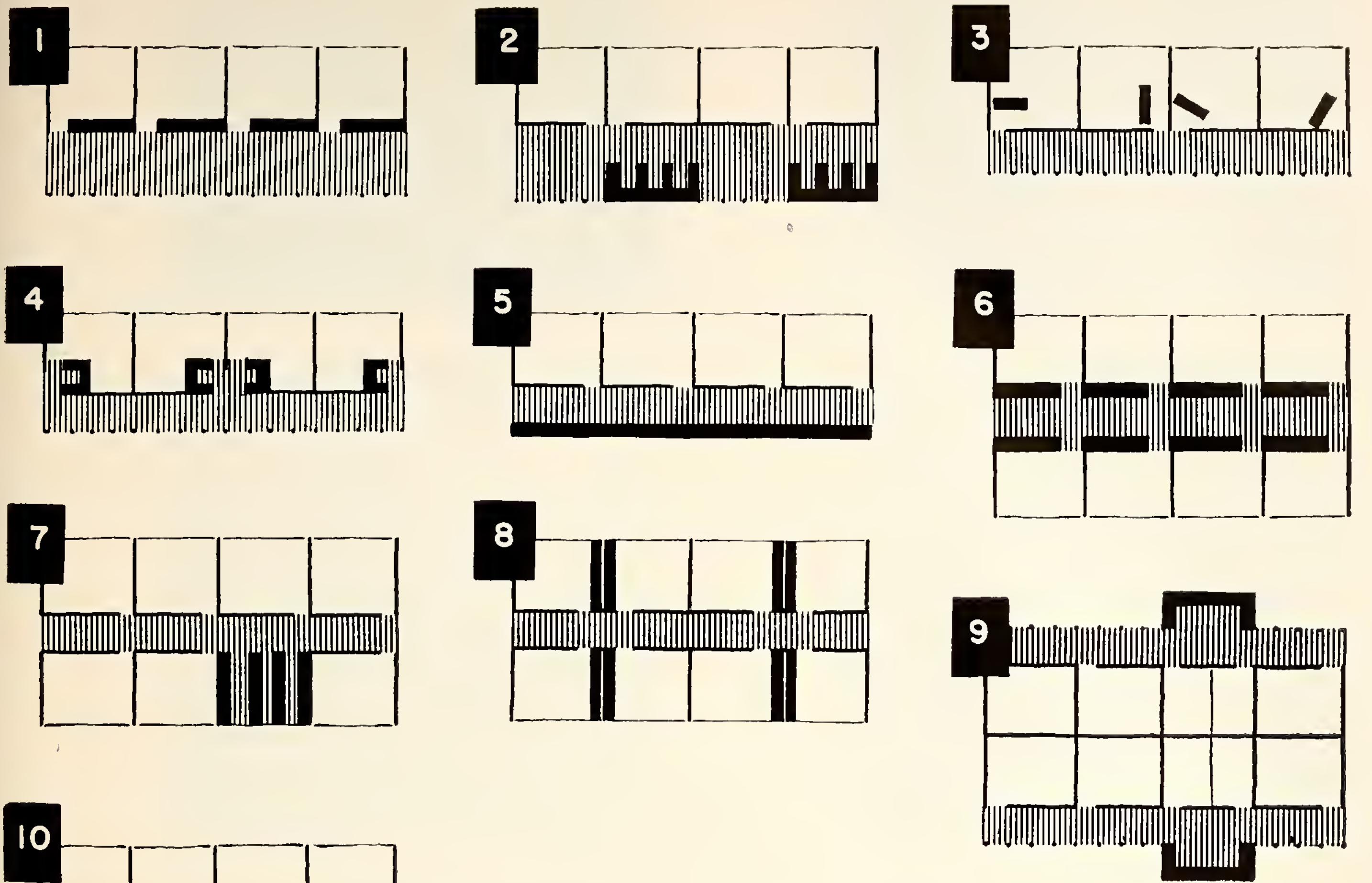
Arctitects, when given the assignment to design an administration unit, should find out the most up-to-date planning methods for any kind of office, not just for school offices. According to Blatner, he should study the advantages of administration wings of factories which often have different scale and character from main structures. He should study the advantages of offices in stores and restaurants, offices which are accessible but usually remote from the main circulation. He should study the offices of libraries, museums, office buildings, and theaters. This interrelation of the school and non-school building type is shown in the chart on page 181. The large dots represent highly significant relations; the small dots represent somewhat less significant relations.

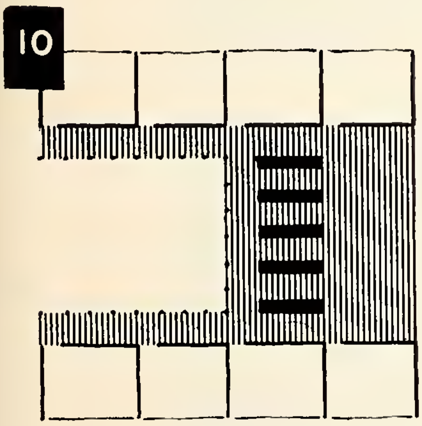
Now consider the second vertical column—the assembly unit. Planners of assembly units should study churches to find out if there are planning techniques involving any seeing and hearing which might be applied to school architecture. They should investigate the use of pews in connection with wider use of benches. Even the hospital, the museum, and the recreation building with their small lecture rooms and assembly rooms should be investigated. And by all means the theater should be investigated because of the close association it has with the school auditorium. If more of this sort of thing had been done in the past, we would probably have no auditorium shells punched full of useless window openings.

Now consider the third vertical column—circulation. School planners should investigate broadcasting stations and study the methods of solving the complex problems of public and staff circulation. They should study the hospital to find new methods for the efficient circulation which is so important to the nursing phase of hospitalization. They should study the theater and investigate the advantages of aisles of varying width as applied to school corridors. They should study residences to see the possibility of using rooms as circulation in lieu of corridors. They should study libraries to investigate the use of stack spaces as circulation areas and sound separators.

Henry Blatner also proposes that school planners correlate the planning techniques of non-school types which might lead to better school eating facilities, and he suggests the study of factory cafeterias, hospitals, hotels, homes, restaurants, and the like. (See vertical

Possible Locker Plans





186. These are a few of many solutions for the arrangement of lockers. Like every other problem connected with school buildings, there is no one perfect solution for the wardrobe and book storage problem. Certainly the conventional steel locker is not the final answer. The noise and high maintenance connected with these units give evidence there is much more to be desired. It is also evident that the traditional arrangement of lockers on two sides of the corridor as shown in Number 6 is not the only solution.

column of the accompanying illustration under the heading of "eating.") He suggests that the planners investigate the success of the kitchen bar of the newer residence, the feasibility of the dining area in the kitchen, and the possibility of eating out-of-doors, as is so often done in modern residences. He also proposes that restaurants and hospitals be studied for obtaining information about food carts servicing the various areas and central kitchens which serve more than one restaurant.

This listing of interrelations of the various phases of planning non-school building types and educational architecture could go on and on. But it is hoped that at least enough material has been presented here to show that we, as school planners, should not confine our thinking to the school plant. We should remember that after all the school plant consists of many divisions of space similar in many respects to homes, offices, stores, shops, and theaters. Those of us who are architects should remember that there is danger in too much specialization. We who call ourselves school specialists should pay close attention to these words by Lawrence B. Perkins, "There is a danger in specialization. For example, there is a great need for significant church architecture in this country. The specialists in church architecture have not produced it. The habit of mind of those who have had the same problem over and over is not to probe, to pioneer or to question things which are

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Storage for Wraps

187-192. These photographs show a few of the many ways which wraps might be storaged. The upper left photograph (187) is a method familiar to most of us. The use of the steel locker in double-loaded corridors as shown in this case is no doubt the most common method. Unfortunately, most inside corridors are not as well lighted and pleasant as this one. The photograph above (188) shows a quite different scheme of storing wraps; note the pair-group division arrangement. The third photograph (189) shows still another quite different arrangement, and a very economical one. Photograph 190 is an arrangement simply composed of pegs and a shelf. The free-standing teaching center (right) screens the wraps from view. The next photograph (191) shows a doorless locker arrangement in the classroom. And the last photograph (192) shows a prefabricated unit which has many possible arrangements. Remember these are only a few solutions for solving the wrap storage problem. All can be improved, particularly the conventional steel locker.

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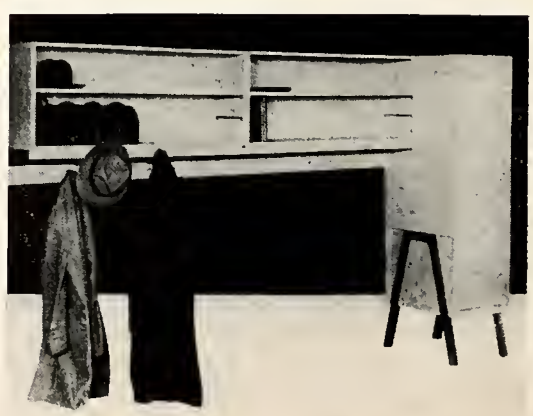

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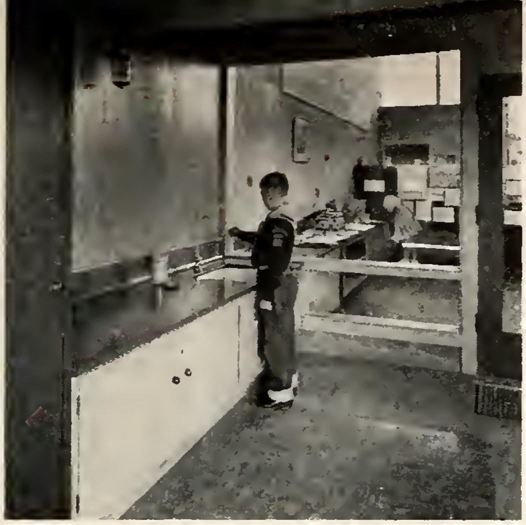

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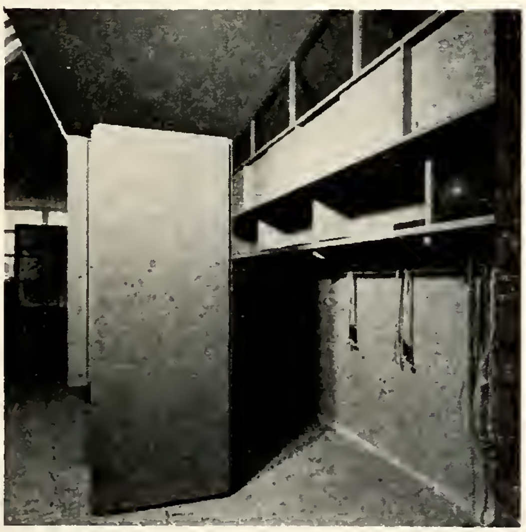
Storage for Books and Equipment

193-198. A teaching space without the storage facilities is like a car without an engine; yet we have classrooms scattered all over the United States consisting of nothing but bare walls. Here are a few examples of storage found in some better-equipped classrooms. Take a good look at the upper left photograph (193)—a case where the storage cabinets in a classroom extend to the outside. This is a classic example of how the indoor and outdoor classroom can be integrated. The boy standing at the sink is on the outside; the girl is on the inside. The next photograph (194) shows a well-equipped workroom which adjoins the classroom. The third photograph (195) shows some movable storage units in this arrangement that are grouped on a seat cantilevered from the outside wall. By the use of these units as space dividers, it is possible for the teacher to make innumerable arrangements. Next (196) is a free-standing teaching center consisting of 6 ft. of demonstration chalk board and 14 ft. of tackboard facing the room, and art easels facing the storage alcove. It also includes wardrobe and supply storage for the teacher on the end facing the camera, and bookshelves on the opposite end. The lower left photograph (197) shows an example of combination book and supply storage and built-in workbench. Photograph 198 shows another movable storage unit. Again it should be pointed out that these are only a few solutions, and are related to specific problems.



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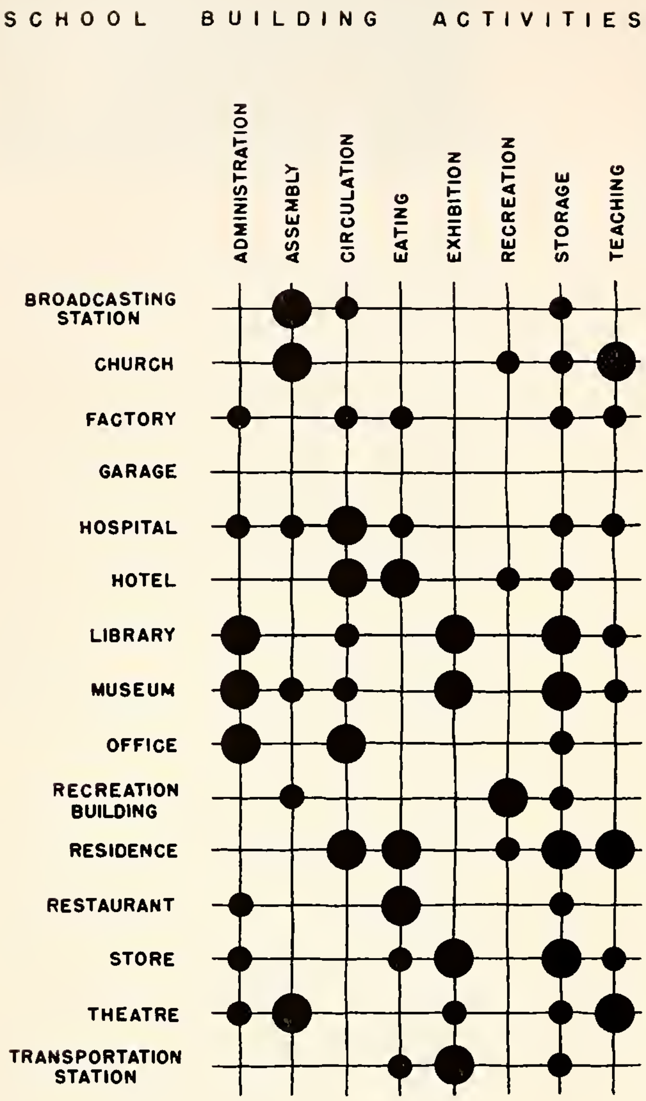


An Analysis of Non-School Building Types Relative to Schoolhouse Design

199. An adaptation of a chart prepared by Henry L. Blatner, Consultant and Coordinator of New Building Studies, and Harry Van Dyke, Senior Research Assistant, New York Commission of School Buildings. Large dots mean highly significant relations, and small dots somewhat less significant.

already acceptable. They, like any other specialists, are most easily trapped by their own past successes. The hope for significant buildings in any category does not lie with hyphenated architects—school-architects, hospital-architects, church-architects, etc.—but with creative ones. We need architects for thoughtful creativeness in anything they touch. Even more important, we need them for the artistry which will serve as a check and balance against too much scientific rationalizing."

CASE STUDIES WHICH ARE RELATED TO CHAPTER 6

No.	*Problem:*
1	How effectively can the space created by parallel open-corrider classroom wings be utilized in the educational program?
2	Can boiler rooms have educational functions?
3	How can a very small school site located in enormously expensive property be best utilized?
5	How can the homemaking unit be designed with consideration given to outdoor living and dining?
9	What is a good way to provide easel painting in kindergarten?
11	Can a school library be designed to serve the community as well as the school?
13	How can the design of corridors be improved?
18	Can toilets be designed to minimize control problems?
19	Can natural lighting be facilitated by plan-layout?
21	What are some architectural techniques of making multi-use of space?
22	Can combination of spaces be used effectively in small community schools?
24	Can corridors be made to serve purposes other than walking space?
26	Can corridor space be used for purposes other than circulation?
27	Can "back-to-back" classrooms be designed for proper natural lighting and natural ventilation?
29	Do storage-wall cabinets make a satisfactory dividing partition between classrooms?
33	What is a feasible way to protect low glass area in elementary school playrooms without marring the beauty of the structure?
34	How can provisions be made for an interim lunch and activity area for the first unit of an eventually complete elementary school?
36	Can both auditorium and playroom be provided at reasonable cost?
38	Can improvement be made over the conventional metal lockers for storing clothes in an elementary school?
42	Can improvements be made on combination of cafeteria service with other school functions in an elementary school?
44	Can outside space be arranged to facilitate classroom activities?
48	How can controlled lighting be achieved on east and west fenestration?
49	Can an elementary school be built on a precipitous site?
50	Can classroom storage be housed to advantage in movable cabinets?
51	Is a semi-outdoor school feasible?
52	Can a large school be planned with an intimate, friendly character?
53	Can classrooms be designed for dining purposes?
54	What facilities are necessary for outdoor teaching?
55	How effectively can the site be used to enhance the beauty of architecture?
56	Can a highly compact school plant have decentralized classrooms?
57	Can the space of the corridors in elementary schools be captured for use in the classroom?
58	Can corridors be used for teaching purposes?
59	How effectively can a large auditorium, a little theatre, and an arts and crafts unit be combined?
60	Can the gymnasium, the auditorium, and the cafeteria in elementary schools be combined successfully?
63	Can the advantages of outside and inside swimming pools be combined?
64	What kind of a layout is suitable for au area of heavy rainfall?
65	How can we improve the appearance and scale, and encourage multi-purpose use of playrooms?
66	How close can we come to ultimate flexibility in practice?
67	Can dining and reading spaces be combined?
68	Is the central kitchen feasible?
71	How can you eliminate the floor space generally used by a platform in a multi-purpose room?
72	How can special purpose facilities for an eight-classroom unit be designed to take care of an ultimate eighteen-classroom unit?
73	Can an auditorium lobby have a multi-function?
74	Can very large assembly spaces be multi-functional?
75	Is a campus school layout desirable for northern climates?
78	How can we achieve a rational method of corridor storage of outer clothing for elementary grades?
79	Can corridors be eliminated?
80	Is the conventional teacher's desk the best solution to the teacher's work area and storage problem?
81	What type of classroom will best suit small group activities?
82	How can a gymnasium be subdivided for both boys' and girls' activities?
83	How effectively can skylights be used for playsheds?
84	Can stages have maximum flexibility to conform to the high school program?
87	Are the requirements of flexibility and economy compatible?
91	How can teaching devices be grouped for effective use?

CHAPTER 7 THE PLANNING PROCESS AND THE SCHOOL PLANT

All of this book describes and argues for a rational and balanced approach to the planning of schools, and, more specifically, each chapter has contributed something meant to be helpful in the formulating of an organized planning process. The opening chapter emphasized that since schools exist for the pupils, any planning, and any phase of planning, must be done with the pupils in mind. The next three chapters discussed in turn the three major planning factors—education, environment, and economy—and pictured them as the three interdependent legs of a tripod standing within the circle of the pupils' needs. The fifth chapter discussed city planning and tried to show that planners must think of the school as an integral part of the neighborhood and city. Chapter six discussed that part of planning which is concerned with the arrangement of spaces for effective educational use. This chapter attempts to crystallize all of this into the practical "what, who, and how" of the planning process.

THE PLANNING APPROACH . . .

Up to now the word "approach" has been mentioned many times. This stands to reason because this book is about an approach, often referred to as *the* approach. But there are others. One approach to the planning of a building is to select a favorite from among the many traditional forms of architecture and to cast the new building, no matter what its time, its place, its site, or its function, into that form. That is one way. That was the way selected, for example, in the design of one large and widely known public institution in the Middle West. This impressive gothic structure was financed, at least in part, by one of our great American philanthropists, as so many institutions fortunately have been. Perhaps the most significant comment on it, and indirectly on all buildings erected from this approach, was that of Louis Cazamian, noted French scholar and critic, who some years ago stood on its spacious lawn, gazed fondly up its imposing tower entrance, and murmured, "*Ah! Notre Dame du gasoline!*"

This is an approach, and an understandable one. Everyone appreciates great traditional architecture. Everyone recognizes the greatness of the Parthenon, of Santa Sophia, of Monticello and Mount Vernon, and of the twin-spired cathedral at Rheims. But everyone should limit his respect, as Mr. Cazamian does, to the genuine Notre Dame.

What most people do not realize is that all of these structures are the products of the most advanced thinking of their respective times, and were constructed by the most skilled artisans using the latest techniques. They were "modern." They stand today not as examples of ultimate crystallized forms, but as testimonies to the creative minds of their designers. They demonstrate clearly that it is the *approach* which should be copied—not the architectural forms.

In terms of modern school planning, such an approach would be based on the needs of the child. It would take into consideration the most up-to-date methods of lighting, heating, and ventilation, take advantage of the latest materials and methods of construction, and utilize all the benefits of mass-production labor. It would bring into full play the potential of creative architecture and would result in efficient and logical school planning which would give the children not only functional buildings that the taxpayers could afford, but beautiful, friendly buildings that the children would appreciate.

It is the traditional approach to possibly great architecture we wish to copy, not the traditional forms of great historical architecture, or even of great contemporary architecture. We have more to fear from the modern eclectic than from the designers who make use of the old traditional forms to cover up planning mistakes. All the really good buildings of any age are the result of this traditional approach of good creative architects. There is no universal architectural form. There are no inherited building plans. There are no standard schoolhouse solutions. There is only the realization that no two school building problems are alike, and that each building must be tailor-made to its own time, its own geographic section, its own specific location, its own specific functions for its own users.

But the tailoring is more complex than at first might seem apparent. To begin with, it requires a panoramic point of view.

. . . REQUIRES A PANORAMIC CONCEPT

A plowed field, to select a clarifying example, looks rough to the farmer who is sowing it and smooth to a pilot flying twenty thousand feet above it. It looks large to the farmer and small to the pilot, a handful of its dirt provides a third point of view; a speck under a microscope reveals a fourth. The farmer, the pilot, the housewife, the child, the casual passer-by, the soil analyst, the artist—all see the plowed field differently, each according to his own kind of knowledge and interest. Who is to say any of them is wrong? And who could insist that his observation is the only one, his image the true one?

Is not looking at a school or considering the planning for a school something like this? Here, too, there are many observers, each with his own point of view—members of the building committee, the finance committee, and the site selection committee, the superintendent, the teacher, the building custodian, the architect, the illuminating engineer, the heating and ventilating engineer, the acoustical engineer, and the sanitary engineer, not to mention the children for whom the school is to be built.

What each of these people sees is right. Yet what each of them sees is wrong.

The heating engineer, for example, sees the ideal school as one with very little glass area; he is right because this would decrease the heat loss, and he is wrong because this would also reduce natural lighting. The sanitary engineer sees the ideal school as one with hard-glazed walls; he is right for hard-surfaced walls facilitate cleanliness, and he is wrong for such walls generally make for poor acoustics.

Each of these planning concepts is limited. Each is right within its limitations, but wrong, except by accident, beyond them. And no one man ordinarily is able to study the planning problem from all pertinent points of view. Planners of schools generally have been proceeding with only partial evidence, with an incomplete concept which violates a basic rule in inductive study: that evidence must be gathered from more than a single observer. For a complete understanding of the specific problem in planning any one school, it is necessary that many eyes study that problem from many positions. It is vital that many separate but limited points of view coalesce into one total planning concept. Logical, totally acceptable schools can result only from total planning.

WHO PLANS SCHOOL PLANTS: THEIR ATTITUDES

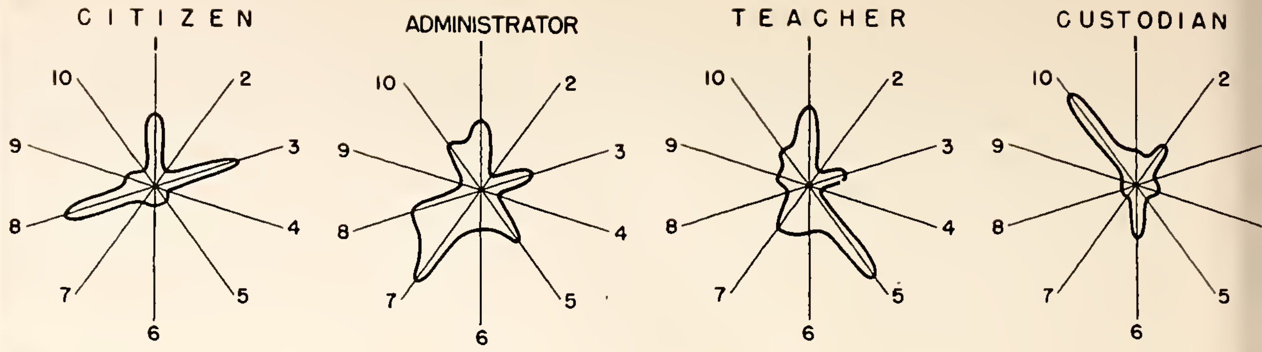
Unlike a mere engineering job, the total planning of a logical school demands the cooperation of a number of people with different interests, and such cooperation should be utilized in directed effort, not in mere casual conferences. Already these names have been mentioned: the architect, the educational consultant, the superintendent, members of the school board, the principal and his teachers, the illuminating engineer, the heating and ventilating engineer, the acoustical engineer, the sanitary engineer, the building custodian, and even the pupils. Add to these a list of the various specialists connected with the many building materials, of experts on school furniture, and of the various citizen group committees who work toward achieving new school plants, then the list of school planners might be complete.

It is very difficult to draw definite lines of responsibility for these planners because so many of their duties overlap, and consequently so do their responsibilities. At the time of this writing the National Council on Schoolhouse Construction and the American Institute of Architects are trying to prepare a document with a clear cut statement of responsibilities. But even if this document is produced, there will always be exceptions because the success of total school planning depends largely on leadership. And leadership depends more on personality and knowledge than on licenses to practice a profession or on the rank and classification of academic degrees. But the architect and the school administrator do, without question, play major roles. The educational consultant, who is becoming more and more important in the school planning picture, is generally employed by the school board to supplement the planning experience of the school administration. Engineering specialists do about the same thing for the architects, and they are generally employed by the architect.

The seriousness of planning cannot be overemphasized. Not only are there certain legal responsibilities such as those which are in the process of being documented by the N. C. S. C. and the A. I. A., but there are also certain professional responsibilities. For example, consider the Superintendent of Schools. There are no laws that say he must administer the educational program with sincerity of purpose and in the best interest of the children, that he must adhere to the principles of integrity, and that he must have honesty of purpose in his pursuit of adequate school plants. But he is a professional man, and the good school administrator needs no laws. He has no easy task before him when he sets out on a school building problem. Unfortunately, the more he works toward achieving the best possible school plant, the more he is criticized. And conversely, the less he aspires to the best, the less he is criticized. Of course, there are always exceptions, but generally, the road for pioneering anything is rough, and pioneering better school plants is no exception, particularly when taxes must be raised. The easiest thing for a school administrator to do is to just sit back and "get by." But that is not the professional thing to do.

On the other hand, successful school building pro-

PROFILES OF PLANNING KNOWLEDGE



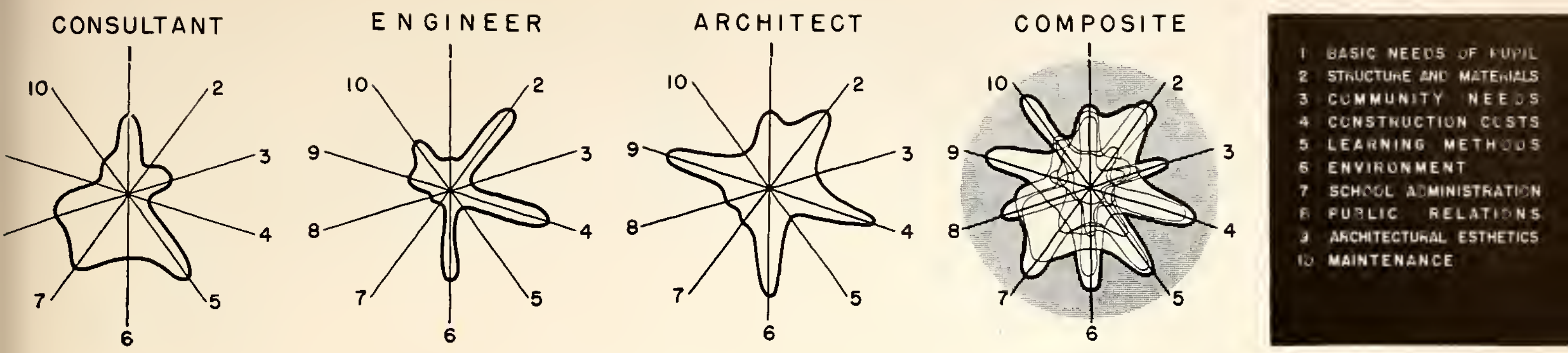
200. One person alone cannot design a successful school plant. Under the combined leadership of the architect and the school administrators, the planning process involves many people with different interests. In order to illustrate why this varied group should be called in, consider the sketches above. Let us assume, for instance, that there are ten major considerations of planning the school plant. These ten are listed above. Now let us assume that the amount of knowledge of each of these ten could be plotted on a spoke-wheel chart and through the examination of each of these many school planners "profiles" of the planners' ability could be plotted. For example, consider the profile of an interested citizen who wants to help plan schools. See diagram under Citizen. His profile might be something like this. In the first major consideration of planning—a knowledge of the basic needs of youth—this particular citizen may rank very high. Since he probably knows very little about structure and materials, he would have a fairly low rating for the second consideration. But he may, because of his civic work, have considerable knowledge about the third consideration pertaining to community needs. Because he is neither an architect nor an educator, his score for the next four considerations would be very low. Now let us assume that because of his work in civic activities, he is in an excellent position to know the "pulse beat" of the community. If so, he would receive a very good score for planning considerations, number eight. And because he knows very little about architecture, esthetics, and maintenance, his score for the last two items would be low. So the profile of this particular citizen would look something like the diagram shown.

grams have raised the professional status of many school administrators because they had the courage to give the children what they thought they needed, not what disgruntled taxpayers thought they should have. In every case these courageous superintendents were criticized for having deviated from the beaten path. They were criticized when they permitted the architects to throw away the fasle cupola, the useless "gingerbread," and the second and third stories. Their critics blamed them for letting the architects design "chicken coops," "horse barns," and "shopping centers." But because of their courage to withstand criticisms, we are beginning to get some beautiful and logical school buildings for our children. Perhaps the hard-pressed superintendent who is trying hard to assume professional responsibilities may find consolation in the thought that: no one ever kicks a dead dog.

The architect too has responsibilities of professional integrity. He, too, is criticized for getting off the beaten path, for breaking away from outmoded planning techniques, and doing what he thinks is best, and he, too, must have an honesty of purpose. The easiest thing in the world for the architect to do is to make his office into a plan factory, to elaborate the client's sketches. But as a professional man the architect does not sell plans; he renders services. He diagnoses, consults, prescribes, and practices with the skill, the care, the professional independence, and the inviolable ethics of a good doctor. Otherwise he does not deserve his license. and school planners ought to have nothing to do with him.

Architect Donald Barthelme, one of the most highly skilled and creative architects in the nation, adds another point to the discussion of professional responsibilities when he says, "I think it important that the architect realize that each job is a responsibility rather than an opportunity; the painters, sculptors, writers, etc. all have opportunities, but the architect builds and therefore conditions environment that the rest of mankind cannot escape; hence, the responsibility. This eliminates the show-offs, the virtuosos, and those who 'express themselves'; in many cases our most useful leaders in design, whose efforts, though frequently painful to their immediate clients et al, perhaps build sufficient justification in the long run through the avenues they open to those with stronger consciences. The architect's responsibility in doing his task beautifully is inherent and is due to the history of his profession, but it does not excuse him from his responsibility in the first category."

There seems to be some conflict at times between professional responsibilities and professional capabilities; it is hard to separate what an architect should do from what he can do. Barthelme presents his thoughts on this subject when he continues, "Now it is impossible for us all to be Wrights, Corbusiers, etc., and it's better so, but rather than straining at that fact or aping the work of such men, we should be modest enough to

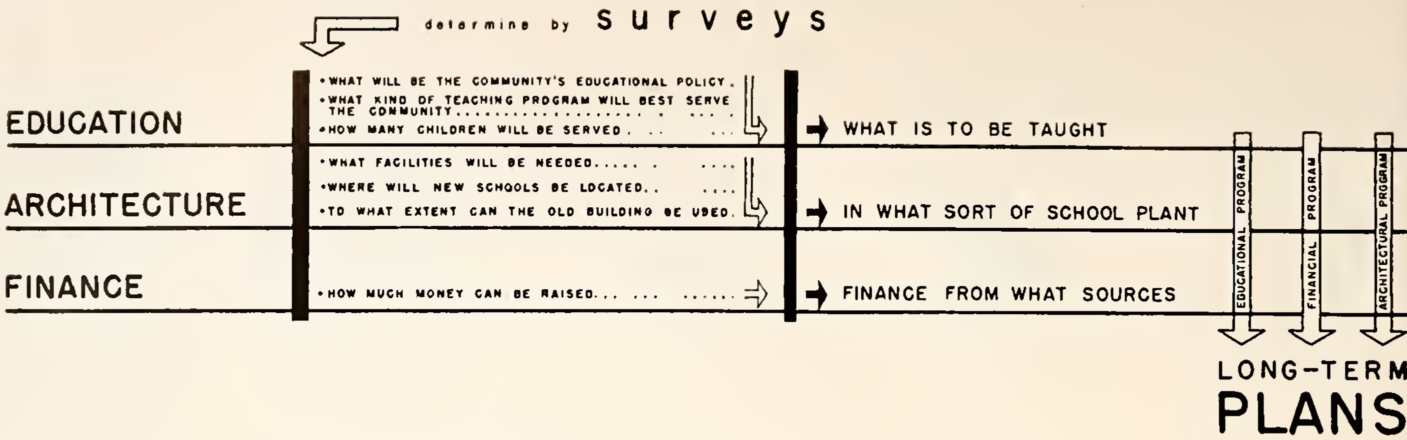


Now let us consider the profile of a certain teacher. On item number one, assuming that she is a good teacher, she will get a high score because she will have a thorough knowledge of the basic needs of youth. On item two, of course, she would have a very low score, but it may come up somewhat in item three if she is alert to the needs of the community. It is assumed that she knows nothing about construction cost, therefore her score for number four is negligible. But since item five relates to her experience and training, this particular teacher would rate a very high score. As far as item six is concerned, she may have a high score for the simple reason that she is in a pretty good position to tell whether the environment is comfortable. Let us assume that she knows a little about school administration but not too much, so some score is registered for item seven. And depending on the individual, she may register some score for the last three times. The same kind of plotting of these profiles could be done for any particular administrator, custodian, educational consultant, engineer or architect. Naturally they would vary according to the individual. A top-flight administrator's, or for that matter top-flight architect's, curve would appear to be a much more round profile, which approaches the outer limits of the diagram. But regardless of how competent such a person is, his profile will never be completely circular or at the limits of knowledge. The composite curve of all of these planners does approach the ideal. Of course, it never reaches it, but it gets near enough to it to make the democratic process of planning worthwhile.

be content with employing our own resources to their best use. Obviously, it is we who are not the Wrights and Corbusiers that really, through our numbers, determine most of the environment. And our concern for them or assumptions of greatness consume too much of our capacity for our own much more modest accomplishments. Here, too, I would castigate the phrases 'form follows function,' 'honesty,' 'expressing structure,' and the like. As long as we try to follow formulas not ours, or worry with other men's *tours de force*, so long will we have little time for the development of ourselves. This is in effect an expression of confidence in the human animal, guided by honesty in conscience, being able to solve problems in environment with acquired skill and appreciation of beauty."

Only the superintendent and the architect have been discussed, but it is hoped that the reader will see that every planner must realize his moral and professional responsibilities and have the courage to carry out what he thinks is right. The good school planner must have his own convictions and at the same time respect the positions of others. All must believe in the total planning concept, and work together in the interest of their common goal. It is particularly important that the educators and the architects work hand in hand; as Morris Ketchum, Jr. puts it, "The best school architecture is always produced by close teamwork between educators and architects—not by dragging some stereotyped solution out of a plan file and trying to adapt it to a new program and new sites. There is no such thing as a good stock school plan. Every new school building should and can be tailor-made to fit the teaching needs of its own community. There is no easy road to the production of a successful school building, either. Every community should be sure that the architects it selects are just as eager as its educators to explore and weigh alternate solutions to the problem of creating an ideal school plant."

It might be appropriate here to say a word more about the "hyphenated architects," mentioned by Lawrence Perkins in the preceding chapter. Some architects have been hired because they are "school architects" who have had the experience of planning "dozens and dozens" of school buildings. If the school board considers only the services of the self-labelled school architect, it hurts itself and architectural progress at the same time. Such a decision eliminates the many excellent young architectural firms just starting out, and it also keeps out the experienced architects throughout the country, who, for one reason or another, have never had the opportunity of designing schools. Evidence? Here is some. The first school by Perkins and Will was the famous Crow Island School. One of Ernest Kump's first schools was the Acalanes High School. The prize winning Blackwell Oklahoma Schools were Caudill, Rowlett, Scott and Associates' first attempt (Refer to Case Studies 73 and 91). John Lyon Reid's famous Fairfax School was the first school de-



201. Here is a graphic outline for the development of long-term school building plans. Note that there are three major areas—education, architecture, and finance. Under education there are three questions that must be answered. The answers will forecast what is to be taught in future years. Under architecture there are three questions, the answers to which will determine what sort of school plant will be needed in the future. And under finance, the main question is how much money can be raised and from what sources. The answers to these questions are generally determined by survey. The results of the survey will be the development of a long-range educational program, architectural program, and financial program. These three combined will make up the long-term plans for building.

signed by his firm. And the experienced firm of Ketchum, Gina, and Sharp, who had been designing prize winning stores for years, had never been given a commission to design a schoolhouse before the famous Darien, Connecticut, project. (See Case Studies 7, 13, 18, and 80.) The important qualifications of an architect are superior skill, the desire to do the best he can, and the willingness to cooperate with other planners. A school building program may be organized to the Nth degree; it may have the most eager and enthusiastic administrator; and it may include the services of the most competent educational consultant; but if it has mediocre architects the chances of its failure are great. Probably the same might be said of other planners, but it is particularly applicable to the architect.

FIRST THINGS FIRST; THE DEVELOPMENT OF THE LONG-RANGE PLAN

No one would ever start out on a long automobile trip with an empty gasoline tank, or without having planned it and collected the necessary maps. But it is a common occurrence to find school building programs started without enough land to go very far and without any sort of definite idea of where they eventually are to go. A surprising number of school officials and interested citizens starting out on a building program are apparently unable to recognize any but their immediate needs. The unhappy truth is that no individual plan exists in isolation, no matter what the intentions of the planners. Every school building construction program, whether it be a small renovation project or a completely new building, is a part of some sort of continuous school building program. School plants are never finished. They have continual growth, or at least continual use, requiring maintenance and sometimes remodeling. If not, they are abandoned and torn down. The problem is ever-present, affecting each new school and being affected by it, but never finally solved.

Since the school building program is necessarily continuous, it is only reasonable that it should be controlled, that each new school be integrated into a long-range general plan. So in the planning process of developing the school plant, the first thing that must be done is to formulate a long-range plan.

What is a long-range school building plan? It is simply an inclusive general program which anticipates and provides for both immediate and future school building needs. Many communities, building today for tomorrow, are saving taxpayers thousands of dollars by fitting immediate construction into well-mapped, ultimate building programs. They realize that to try to anticipate tomorrow's needs is somewhat of a gamble, but they also know that to disregard those needs is a dead certain loss.

Who makes the long-range plan? Sometimes communities hire professional educational consultants to do some or all of it. Sometimes architects extend their services to include long-range planning. Sometimes colleges offer this service. But in many cases local educators and interested citizens themselves have studied their own needs and have produced excellent long-range building plans.

Who is to make the plans is an important question, but almost equally important is the question of how the plans can best be sold to the people. And the answer to that question is to encourage the people to participate, insofar as possible, in the developing of the plans they will be asked to support.

How is a plan developed? There is no standard procedure for developing a long-range school building plan —there cannot be one. School administrators differ. Communities differ. Situations differ. Small communities require less complicated plans than do large cities. But no matter who draws up the plan, or what the

specific situation, the main problems involved are always the same. These have been mentioned before in this book, and they will be mentioned again in this chapter:

> EDUCATION: What and how will the faculties be teaching during the next five, ten, twenty years?
>
> ARCHITECTURE: What sorts of school plants will these subjects and methods require?
>
> FINANCE: How will the necessary facilities be paid for?

Any adequate plan must provide at least tentative answers to questions related to all three of these phases. How is this to be done? There is no one procedure, and any method is certain to be complex. Planning for the future is never easy. The procedure based on recommendations stated in *Your Schools*[28] and outlined in the pages following is only one of many ways of going about this difficult but prudent task. In general it will suffice for most communities, but in detail it will have to be altered to fit the particular characteristics of each individual community. This suggested approach poses seven questions—three under EDUCATION, three under ARCHITECTURE, and one under FINANCE—which center attention upon the specific considerations indispensable to any long-range plan. Most of these have been treated elsewhere in greater detail; they are offered here for emphasis. For a graphic outline refer to the accompanying illustration.

LOOKING INTO THE FUTURE TO SEE WHAT IS TO BE TAUGHT

The *first step* in developing a long-range school building plan is to find out what will be the educational policy of the community. This policy should specify whether community education is to start in the nursery school, in kindergarten, or in grade one—whether it is to terminate after eleven grades, after twelve grades, or after two years of college-level training. It should take a definite stand on adult education. It should decide the ultimate grade grouping—a six-three-three, a seven-two-three, or some other division agreed to for many years to come. It should make clear whether the school board or the municipal government is to be responsible for the community recreational program.

How can this policy be determined? It must come from the people themselves, not from the educators alone. There are a number of things the planners can and should do, chief among which are these:

1. Conduct public forums.
2. Start group discussions within as many as possible of the local service organizations.
3. Seek counsel of leading educators.
4. Publicize both the preparatory activities and the resultant statement of policy.

The *second step* is to find out what kind of a teaching program will best serve the community. To answer this question the planners will have to discover the particular educational needs of their own community. Is there a health or delinquency problem that could be solved through the schools? Is there a demand for high school graduates specially trained for some local industry? Could a lagging cultural interest be stimulated by a well-rounded teaching program? These are not the only questions, but they are representative, and of the many ways to answer them, the following have been used successfully in many instances:

1. Collect historical and factual information concerning the community. Such information helps to anticipate community growth, interests, and economic trends. It can be obtained from the municipal offices, the community library, the Chamber of Commerce, and the individual old-timers who will appreciate being asked.
2. Collect factual information concerning the people—their housing, their recreation, and their religious activities. A house-to-house survey is probably the best method of getting this information, and it is quite possible that the civics classes of local high schools can do the job. If necessary, information about delinquency may be obtained from the city and county records.
3. Collect health information from the community health officer, and, if improvement is called for, try to incorporate a health program into the curriculum.

With this information the trained educator can formulate a curriculum tailored to the needs of the community.

After the community's educational policy has been established and after the recommended teaching program has been set up, then the next job is to evaulate the existing curriculum. Is it consistent with the educational policies as formulated? William R. Flesher and his associates of the Bureau of Educational Research, Ohio State University, a few years ago made a study of the educational needs of Watertown, New York.[49] Their report was made by evaluating the curriculum of the secondary schools on the basis of the following eight criteria: These are still good today, and they are submitted here because they will probably still be good a long time hence.

1. Is the curriculum based upon a unified, consistent, democratic philosophy which has been determined cooperatively by the administrative staff, the teaching staff, and others concerned directly with the secondary schools?
2. Is the curriculum of the school determined cooperatively by those who are directly concerned with the day-to-day work of the school?

3. Does the administration of the school provide effective leadership in the cooperative solution of problems pertaining to curriculum reorganization?
4. Does the curriculum provide adequately for a program of general education for all youth and at the same time meet the specialized needs of each pupil?
5. Are learning activities selected, planned, and directed in terms of democratic values and sound principles of learning?
6. Are the various fields of knowledge and the student activities closely coordinated or unified?
7. Is the guidance program of the school dynamically related to the day-to-day activities of the classroom, or is it regarded as a separate function?
8. Does the evaluation program test for the achievement of the attitudes, understandings, and skills which are explicit in or implied by the basic philosophy or purposes of the democratic high school?

All of this seems to be straying away from the planning for new school buildings, but actually it is not. Architects are not professionally interested in forcing changes in the educational policies of any community, but they are interested in the community's having a policy and a definitely committed teaching program. In order to design an effective school building they must know exactly what kind of a teaching program is to be followed in and out of that building, and the community's own interests require that the teaching program be stable enough to take full advantage of buildings designed for it. Teaching programs and community policies change easily, even casually, where they are not consciously developed; buildings obviously cannot change except at great trouble and expense, although some architects are trying their best to ease the financial pain of such changes.

The *third step* is to find the answer to this question: How many children will be served? Since this question has been discussed in so much detail in Chapter 5, let the following procedure for studying enrollment trends suffice:

1. Make a population survey. The Bureau of the Census is the chief source of information. At the state and local levels, study emigration, immigration, and birth rates. Locally, consider the possibility of new industries coming, old ones leaving. The local Chamber of Commerce can often furnish reliable figures.
2. Make an enrollment survey. Again the Bureau of the Census is the chief source, but the U. S. Office of Education also has some excellent data on national and state enrollment trends. For local trends, survey past enrollments.

To answer the question, "How many children will be served?" planners can plot the curve of past growth and extend for future growth, remembering that national and state growths are reflected in local enrollment except in very unusual cases. By a graphic method, future enrollment can be calculated for the next five, ten and twenty years and applied directly to a long-range building plan.

WHAT ARE EDUCATIONAL SPECIFICATIONS?

These first three steps sometimes come under the heading of "educational specifications." Top-flight educator John H. Herrick, with his excellent background in the school planning field, has this to say for the value of such specifications: "School people have long said that a school building should be designed around the educational program of the school, but in practice they have often left the planning of a new building largely to the architect. Of course, they have given him suggestions as to what they want in the building, have answered his questions from time to time, and have criticized his plans. A procedure which is more certain to produce suitable educational features in the new building, with a minimum of re-drawing of plans by the architect, is to prepare in advance a set of detailed educational specifications. These specifications should be prepared by educators, preferably with the advice of the architect, and should be based on a realistic but farseeing view of the future school program. They should be set forth in sufficient detail to enable the architect to grasp the philosophy behind them, but should not engulf him in unnecessary pedagogical jargon. They should provide the basis for the architect's preliminary drawings and should not leave for him any unanswered questions of educational nature. Likewise they should not dictate to him the solutions which he should use to purely architectural problems."

The writer can add no more, except to say that school architecture needs more educational foresight and less educational hindsight. Well developed educational specifications will give us the foresight.

LOOKING INTO THE FUTURE TO SEE WHAT IS TO BE BUILT

The next three steps (4, 5, and 6) will have to do with the architectural needs. The *fourth step* is to find out what facilities will be needed. This sometimes comes under the heading of "programming." In order to answer this question, planners will have to study their answers to the form preceding the questions. If they know what is to be taught, how, and to how many students, they can determine the facilities needed by these two steps:

1. Find out *what kinds* of facilities are needed. By a careful study of the recommended curriculum and of the established educational policy, devel

op a list of the types of teaching spaces needed—instructional units, assembly units, recreational spaces (indoor and outdoor), dining units, administration units, and such special facilities as libraries and visual aids rooms. Do not forget to include in this list the types of equipment needed. The equipment in a classroom is no less important than the motor in a car.

2. Determine *how many* of each item are needed. From the enrollment forecast find out the maximum number of students which will use the various facilities at any one time in the next five, 10, or 20 years, and then calculate the space and amount of equipment needed by this maximum in each grade.

With these findings the planners can translate the educational needs into building needs in a specific building program based on facts, not guesswork. This phase of long-range planning is one of the most important and requires much skill and deliberation, as well as close collaboration between the architect and the educator.

The *fifth step* in developing the long-range school building plan is to find an answer to that ever-confronting question, where will the new schools be located?

This question is considered in some detail in Chapter 5, but it is listed here because it is one of the most important and complex problems in long-range planning. School planners will do well to be particularly thorough in studying this question, basing their answers on their own adaptations of the seven steps in selecting a good school site:

1. Find out where the students live.
2. Find out where the preschool children live.
3. Find out what land is available.
4. Check up on the zoning ordinances.
5. Determine the boundaries which might hinder residential expansion.
6. Study traffic patterns.
7. Determine in which directions the community will grow.

The *sixth step* to take—and the last one, in the architectural phase of the long-range plan—is to find out to what extent the old building can be used. This was considered in Chapter 4 in the discussion on economy, and it rightly belongs there because the existing plant represents a great investment to the taxpayer, and certainly an economic factor in any school building program. It is only natural that any group of planners will want to use the old buildings to fullest advantage. But they should draw the line somewhere; buildings do outlive their usefulness. Objective planners might find it economical in the long-range view to abandon an old building which requires much maintenance. They might find it best to tear down others because they are unsafe, or because they are unfit for educational purposes. Of course, they might also find that existing buildings will fit satisfactorily into the ultimate school plant. The problem is undoubtedly ticklish, and the answer to it should be reached not by predilection, but by a careful survey of the existing school plant from a number of points of view:

EDUCATIONAL: Does the building suit the educational program? If not, is it economically feasible to renovate it?

MAINTENANCE: Does the building require heavy maintenance? Would immediate repair cut maintenance enough to justify the expense? Or would it be best to tear down the building?

SAFETY: Is the building safe? Can it be made safe without unreasonable expenditures?

LOCATION: Is the building properly located? Does the location of the existing building offset the advantages or disadvantages of the structure?

Turn back to Chapter 4 and review the Evaluation Sheet (Illustration page 107.) for scoring the worthiness of an existing school plant. Perhaps the use of such a scoring sheet will tell to what extent the old building can be used.

There is another question concerning old buildings, and it definitely affects the long-range plan. Must an addition to an existing building or an additional new building to a campus be made to look like the old structure? The writer wishes to take a definite stand on this time-worn question, although it may appear to be like beating a dead horse. Why should new additions look like the old structure? What if Henry Ford had decided in 1920 that from then on his company would make only 1920 Fords for the next 30 years? Education changes from year to year; architecture should change with it. Do not build carbon copies of architectural mistakes in order to have "harmony" with existing structures. If architecture is incongruous with its time, there is no "harmony" about it. (See illustrations 110 and 111.)

Architect J. Stanley Sharp stands behind the writer with this statement: "As for our thinking on additions, I don't think the fact that a contemporary building doesn't match a colonial building should disturb anyone. People go all the way to Europe just to see beautiful Romanesque buildings with Gothic additions, Gothic buildings with Renaissance chapels, and so forth, and everyone has a fine time. Even if schools insisted on carrying out a traditional style they'd be licked before they started by two simple facts: (a) the amount of daylight required for a classroom would—and does, all over the country—make a school in the traditional style an empty mockery, (b) no school board can afford the quality of materials and the amount of skilled

craftsmanship essential to a decently successful rendition of a traditional style." Even George Washington in planning Mount Vernon did not see fit to accept "traditional" architectural forms in the construction of additions. Mount Vernon as it stands today is the result of a number of innovations, renovations, and additions. George inherited the house from his grandfather and altered and expanded it to suit his own family's needs. Why should he live in a house that was built for his grandfather's time and his grandfather's family? The same applies to today's school children. But old school buildings, like Washington's grandfather's house, can be made up-to-date by careful planning. Additions to old buildings without a doubt should be up-to-date.

LOOKING INTO THE FUTURE TO SEE HOW MUCH MONEY WILL BE AVAILABLE

The *seventh step*, and the last one listed here in the procedure of developing a long-range school building plan, is to determine how much money can be raised now and in the future. What a conscientious group of planners will want is quite likely not to agree with what they can afford. For that reason, and in order to save unnecessary work and disappointment, it is usually wise to establish the financial limits early in the planning process. To do this, planners should consider the following:

TAXABLE WEALTH: Since money to build schoolhouses depends largely upon assessed valuation of local property, a careful study of this source of revenue is essential. For the long-range program these valuations can be anticipated for years to come and plotted graphically much as enrollment trends are projected.

BONDED INDEBTEDNESS: Most states limit the bonded indebtedness by statute. For example, in Texas the maximum bonded indebtedness is 7 per cent of the total assessed valuation of the school district. In Illinois it is 6 per cent, in Massachusetts it is 3 per cent, and in Indiana 2 per cent. This limitation, of course, will affect the borrowing capacity of the school district in direct proportion to how much the district already owes.

STATE OR FEDERAL AID: There are always some districts which have insufficient taxable wealth to provide funds for adequate building programs. These districts have to be aided by either state or federal grants. School planners should investigate all possible financial assistance before arriving at any final long-range building plan.

After making a thorough study of possible sources of funds, planners should formulate a financial plan. The plan made in Stillwater, Oklahoma, illustrated in Chapter 4 (Illustration 94) is offered as an example.

We should remember that most school building money comes directly from the people through voting of bonds. Many bond issues which have failed could have passed had the people been properly informed of the issue at stake. To finance a long-range building program one must have adequate public relations. Dr. Marion S. Smith, a member of the Stillwater, Oklahoma, School Board, has this to say about public relations: "Stillwater people generally are just the same as people every place else in the U. S. So long as they are well informed on any public project, they will go along with it if it is sound. If it isn't they should not anyway. Since the nation as a whole needs more school space and has greater money limitations, school people are faced with building unorthodox school buildings. Therefore, the public should be informed more than ever of the need for a functional building. Public relations is now as much a job for the school administrators, architects and builders as is the actual detailed plan for a new building. If school boards will take the public along with them on any long-range school building program, they will find the job is a lot easier." It should be pointed out that Stillwater had a bond issue defeated eight to one by a confused, misinformed public. Eight months later, after Dr. Smith and his group had launched their public relations program, a well-informed public voted for the bond issue 25 to one.

SHAPING THE LONG-RANGE PLAN

It is possible that the answers to these seven questions might readily shape a long-range plan, but for many communities they will not. The questions oversimplify the problem in a very large community; they are perhaps too many for the very small one. There is no simple long-range plan that can be packaged neatly and offered to all communities. Communities, like people, have individual characteristics; a long-range plan drawn up for one community is no more likely to solve the problem of another than is a medicine prescribed for one person likely to cure another.

The seven questions, however, are specific enough to be helpful. They represent a flexible procedure that can be followed in any community, not a dogmatic solution that might not apply. They can and should be expanded, contracted, altered to suit the requirements of each individual community. And they do interrelate the three main divisions of any long-range plan—education, architecture, and finance.

Furthermore, this suggested procedure only launches a continuous process. Long-range planning should never stop. As the years pass, projected data will become fast, and the forecasts should be revised accordingly. If this is done conscientiously the plan can always look five, 10, or 20 years into the future with relatively little effort after the initial combined operation. A long-range plan represents a sound investment, but its dividends accrue only if it is kept alive and if it is properly used.

THE IMMEDIATE BUILDING PROGRAM

We quite naturally have a more pressing interest in our immediate building program than in developments 10 or more years in the future, and are inclined sometimes to feel that formulating a long-range plan is taking the long route to an elementary or high school needed now. But knowing the advantages, we are usually willing to take that route. We realize that the amount and kinds of work involved in the planning of a single school are almost identical with what is required for long-range plan. And we see quite readily that the greater good for all comes from making the immediate building program an integral part of a projected pattern of development which goes far toward eliminating inconvenience, waste, and error. So the procedure is to develop first a long-range plan, so that any immediate building program might be a part of the long-range plan. If a community has, say, two dozen individual school plants; then there should be two dozen long-range individual plans, as well as the master plan for the entire community.

Now let us assume that the school board is ready to go ahead with its immediate program and build a new school. If it has come this far, surely the architects have been hired and the planning team is well organized, because otherwise the long-range plan could not have been properly formulated. Suppose the new school project is a part of an excellent plan. Suppose the purchased site is adequate and properly located. The architects have been given the assignment to go ahead with the development of the basic plans. They have been told that the new school will be on such and such site, and have been given an accurate survey of the site. They know the site well because they even had a hand in its selection. They know the space requirements, and they had a hand in determining those, too. Are the architects ready to proceed with the sketches? Not quite. For the sketches must be more than diagrammatic layouts of the spaces involved and their relation to the site. These sketches must reflect the trilateral balance among the three great factors of school plant planning—education, environment, and economy. This takes us back to the end of Chapter 1 where we determined that the successful school plant was one based on these three planning factors so inextricably fused that they form a kind of trinity, a three-in-one consideration for making the plant an effective educational tool, tailored to the needs of the pupil. In Chapter 2 we discussed the educational factor and found that the school plant must facilitate to the greatest possible degree the educational methods and the curricula by which that process is controlled. In Chapter 3 we discussed the second factor—environment. We found that one major goal of school planners was to design the envelope to provide an environment of maximum desirability for pupils and teachers engaged in the learning process. We discussed the third factor in Chapter 4, and found that a good school plant is one that can achieve the aims of the other two factors harmoniously within the limitation imposed by the community budget.

Before basic plans are started there must be a discussion among the architects and other school planners on how the "tripod" can be balanced. If one leg is longer than the other two, then something must be done. The fact of the matter is that the process of making the basic plans is the process of balancing the tripod. In order to balance the tripod the architects must set up certain cost controls as mentioned in Chapter 4. And in setting up these controls they must work very carefully with the educators to see where happy compromises can be made, but in arriving at these compromises, the needs of the pupil should never be forgotten. As the sketch in Chapter 1 (Illustration 21) shows, the tripod itself must stand within the circle of the basic needs of the pupil. The realistic approach in the development of the basic plans, therefore, must be made in the direction of achieving a tri-lateral balance among education, environment, and economy. If this balance is not achieved, the sketches and plans are meaningless. The pretty picture approach, exemplified by architects who submit sketches or models to prospective school board clients and say "If we get the job, this is the way we will do it," is not worth the materials the sketches or models were made from. The "I want one like that" approach so often used by school boards who have seen a schoolhouse in a neighboring community is just as bad. Neither of these approaches lead to successful school plants. The recommended approach considers the pupil first, then works to find balance among the three great factors of school planning—education, environment, and economy. And the basic plans must reflect this thinking.

DESIGN FREEDOM: A NECESSARY REQUIREMENT OF SCHOOL PLANNING

It is a very difficult job to achieve this trilateral balance. The task is largely the responsibility of the architect, because it is he who must compose the various spaces into an efficient and effective arrangement and do it within the limits of the community's pocket book. Like democracy, good design comes about through freedom of action. The designer must be free to act, at least within the limitations set up before him by the programming process. If he is restricted by having to work under obsolete state laws, he has not much chance to make a worthwhile contribution. If he is dictated to by uninformed school board members, the architect cannot possibly be in a position to do his best work. If he is told to follow such and such a layout proposed by some school administrator, however sincere, his imagination is so tied down he might as well not have any. The restrictions foisted on the designer put him in the same position as that of a composer trying to

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Ten problems: Ten good solutions

202-211. Do these buildings represent a variety of architectural styles? Certainly these buildings do not look alike. It is true they may have some general characteristics. Some architectural historians will no doubt classify them under some head of a style. But that is not important because architectural styles change. They wear out in time and decay with imitation. The approach to great architecture, however, remains the same, and it grows sounder with time and flourishes with imitation. It is the approach that counts. A common approach to solving school building problems will result in many shapes and forms, depending upon the

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problems to be solved. These buildings shown here represent solutions. They are all fine school buildings because they are solutions to very difficult problems. Some pertain to site, some to climate, some to unusual educational programs, and so on. They represent what can be done by creative architects working hand in hand with associated school planners to find the answers to difficult school building problems. These solutions are not to be copies. Only the approach is to be copied. These schools are included here to show that a common approach will result in many varied and beautiful solutions.

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make a masterpiece by using only a small part of the scale. The designer, like the composer, must have a wide range of freedom.

What is design? No more fitting definition could be given than one by that great and highly respected educator Walter D. Cocking. Doctor Cocking[50] says, "To me, school design means interpreting a school program and the characteristics of the pupils in terms of building spaces—using suitable materials in appropriate ways, and providing for visual, hearing, and bodily comfort and efficiency—so that the resulting structure is functionally useful, artistically pleasing, and combines all elements into a beautiful, comfortable, efficient, and economical building. Good design, then, gives to every structure both a healthy body and an immortal soul." That is just about the thesis of this book. How can good design be achieved? Dr. Cocking has something very worthwhile to say about that, too. He says this: "To create good design takes a lot of doing. It requires a lot of facts—facts about the people who will use the building, their characteristics, their cultural background, their past experiences, their mores, hopes, and ambitions. Facts must be available about the programs which will be conducted in the building. Community organization, growth, and future expansion are other types of information needed. The financial ability of the school district, its debt structure, and other data must be studied in terms of the new plant and others which may be anticipated. The procedures and activities of the school must be outlined as specifically as possible. The building's uses for both school and community activities must be analyzed. The evolving organization of the school requires careful evaluation." And Dr. Cocking ties up this statement concerning the design of school plants with the remarks, "Creative ability of the highest order is required. Technical understanding of the problems involved is a must. Patience and long suffering will be a necessity. There must be a vision of what such a building could be, and a never-ending effort to attain it. Complete satisfaction cannot be secured. Such an attack rules out copying other building designs in whole or in part. (Hurrah for Dr. Cocking!) Recreating past design, no matter how worthwhile it was in its time and place and purpose, is ruled out. Each problem must be solved in terms of its own characteristics. Every community has a right to expect such an approach and such a result. When attained, we will have good buildings beautifully and usefully designed. Progress will be made. We will move forward to undreamed of solutions." Doctor Cocking's remarks point the way to the approach described here.

CONCLUDING REMARKS ABOUT THE APPROACH

This approach is not an easy one. It requires research on the part of every planner. It requires simultaneous thinking. It means work for all concerned. It forces them to work together. It necessitates making original studies. But it is the only way to take the guesswork out of planning schools—the only way to accomplish the planners' objectives without relying upon chance.

There is no question that this approach is demanding. But it is also rewarding. Research means stimulation, an encouragement of the desire for progress, for new and better things; this kind of research does produce schools that are different—different not because of a desire to be different or "modern," but because different problems of different people in different communities demand different answers. And this kind of research means an end to dictation—an end to personal dictation, but more important, an end to the dictation of architectural schools, both traditional and "modern." Following this approach, planners and architects will not force children to attend schools built to look like homes designed for Washington's grandfather, or like cathedrals designed to awe the faithful. Nor will they force the children to study and play in outsized jukeboxes, or in flat, window-walled sheds designed to look different after any one of a variety of misbegotten schools of "modern" architecture. The end of dictation means a return to the freedom of the great architects. It means schools designed creatively to do what they are supposed to do—to serve the pupil.

CASE STUDIES WHICH ARE RELATED TO CHAPTER 7

No. Problem:

- 7 Can improvements in the appearance and economy of hardware be made?
- 13 How can the design of corridors be improved?
- 18 Can toilets be designed to minimize control problems?
- 73 Can an auditorium lobby have a multi-function?
- 80 Is the conventional teacher's desk the best solution to the teacher's work area and storage problem?
- 89 Can the pupil have a part in planning and building the school?
- 91 How can teaching devices be grouped for effective use?

CASE STUDIES

CASE STUDY 1

PROBLEM: How effectively can the space created by parallel open-corridor classroom wings be utilized in the educational program?

APPROACH: During the early stages of planning this school it was assumed (with good reasons) that because of the geographic location outside corridors were feasible. It was also assumed by the planners that if children could be protected from the "blue-northers" (cold winds to and from the Gulf Coast), there was an excellent possibility that some form of learning activities could be carried on out-of-doors most of the year. They asked the teachers about the scheme. The teachers welcomed the thought of additional instructional space, but questioned the interference problem that comes about when "Miss Jones takes her children into the court for a spelling bee and Mrs. Smith is holding her arithmetic class within her classroom." As with most schools there was a cost limitation, and the planners thought that the conventional method of providing outdoor classrooms for each classroom wing would be too expensive a scheme to handle. They thought, therefore, that the final development of the open-corridor court scheme should be made with a common court between the two classroom wings instead of one for each wing. They reasoned that the common court had the advantages both of economy and of protection from the cold, wet south winds and the cold north winds.

SOLUTION: The scheme illustrated above represents the solution which the planners fondly call a "Sun Valley". In essence, it is an activity court 40 feet wide situated between two classroom wings. Both wings have covered corridors on the periphery which give the children rain protection. The roof and floor levels have breaks to avoid confinement and monotony and to conform with the contours. The visual separation between classroom and court requested by the teachers is provided by a system of sight baffles (tack boards) in each classroom. The "Sun Valley" is protected from the cold winds regardless of their direction.

Credits: The Ben Milam Elementary School, Bryan, Texas, was designed by William E. Nash, Architect. The Superintendent of Schools was W. R. Carmichael.

CASE STUDY 2

PROBLEM: Can boiler rooms have educational functions?

APPROACH: The planners designed this school on the premise that boiler rooms definitely have educational possibilities. They asked themselves "Why hide the boiler room from the children?" It was decided that instead it would be instructive to make it conspicuous to them. The approach, therefore, in planning and locating the boiler room, was made towards the interest and benefits of the children.

SOLUTION: The photograph shown clearly indicates the logical method for solving this problem. There is a large picture window through which the children can study the boiler, its pumps, supply lines, and return lines. The main lines are copper and the valves and pumps are painted bright colors for easy identification. The thermometers and dials are large and all face the picture windows so that the students can read them easily.

Credit: The scheme was developed by Architect John L. Reid for the John Muir School, Martinez, California. The Superintendent of Schools was Willard B. Knowles. Photography by Roger Sturtevant.

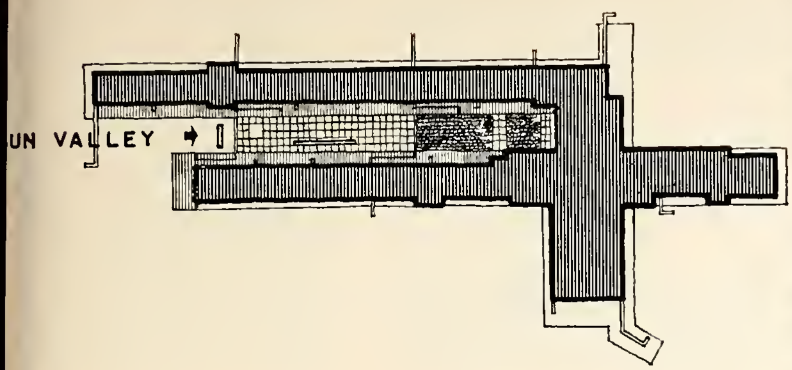
CASE STUDY 3

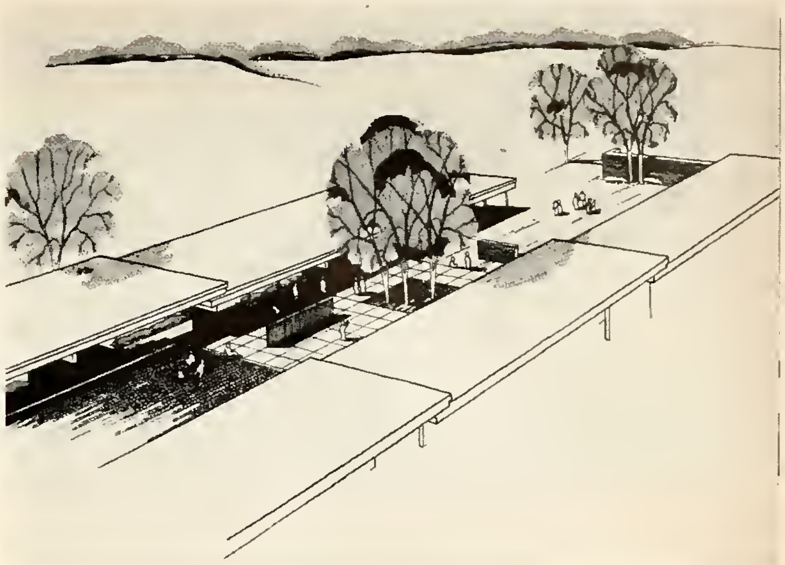
PROBLEM: How can a very small school site located in enormously expensive property be best utilized?

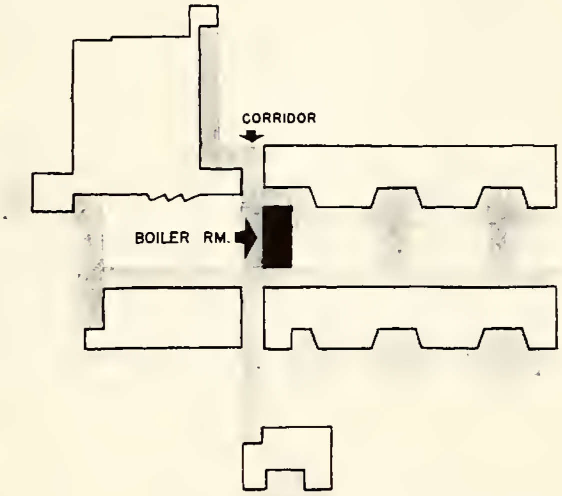
APPROACH: The situation called for a school for about 525 children. The site was excellently located, but its size was far below minimum recommendations—only about three acres of land. Adjacent land could not be purchased because it had a market value of $150,000 per acre. Here is a case where the value of the school land ($450,000) was nearly equal to the building cost ($500,000). In most communities throughout the U.S., if the cost of the land exceeds the cost of a classroom, land is considered expensive. Therefore, the problem confronting the school planners was how to make the minimum site work to its maximum capacity for education. First studies by the planners indicated that the building space itself would take over a large portion of the land, leaving very little outdoor activity space. It was then agreed that an investigation should be made to determine the feasibility of raising the classrooms so that the area underneath might be used for outside activity. It was thought that the main drawback to such a scheme would be cost. Upon further study it was found that because the locality required the school be supported on friction piles, the additional cost of raising the floor was negligible. The approach, therefore, was towards the development of a school on stilts.

SOLUTION: The scheme provides for a school with the classrooms raised about 8 ft. above finish grade. Outside activities may be extended under the classrooms, which act as umbrellas for protection from rain and sun. From this large protected area, stairways located between classrooms lead directly from the shady, quiet play space to the classroom level. The protected area is paved with asphalt blacktopping laid over a shell base.

Credits: This scheme was developed by Curtis and Davis, Architects, New Orleans and Charles R. Colbert, Supervising Architect of Orleans Parish School Board. Photography by Hill Pidalgo, illustrators.


UN VALLEY




CORRIDOR
BOILER RM.

CASE STUDY 4

PROBLEM: Can a double-loaded corridor school be ventilated by natural means?

APPROACH: Planners of this school had to choose in the early stage of the design whether or not the solution to the problem could be found in a building which was located with its axis perpendicular to the wind or parallel to the wind. It was decided that because of site conditions and simplicity of sun control (same method on East as well as West) it would be better in this particular case to try to develop a scheme with the axis parallel with the southern wind. The planners theorized that if the corridor were made large enough, if openings were made in the walls between the classrooms, and if the corridor were closed on the opposite end from where the breeze would enter, the air would flow into the corridor, then through the classrooms and out the east and west windows. The Texas Engineering Experiment Station was then brought into the planning procedure and tests were conducted with a model in a wind tunnel. The first one proved that because of the kinetic energy of the wind, only the classrooms on the back side of the building received proper air movement. In order to have a more balanced distribution of airflow, more tests were conducted which made use of an architectural element—in this case an office—situated in the main air stream to help distribute the air into the front classrooms. The later tests determined the exact size and shape of the office. The approach, therefore, was based on the premise that a corridor could be considered an air plenum chamber.

SOLUTION: The final scheme consists of a 20-ft. all-purpose corridor which serves as an air plenum chamber through which air flows into the classrooms. Grilled slots are provided in the corridor partition. The front walls of the school are flared to help scoop in the breeze. The office in the corridor helps to provide evenly distributed airflow. The corridor serves ten classrooms and is used for such multifunctions as indoor play, assemblies, and exhibits.

Credits: The Fairview Elementary School located at Elk City, Oklahoma, designed by Architects Caudill, Rowlett, Scott, & Associates, Richard Burch, Superintendent of Schools. Photography by Ulric Meisel.

CASE STUDY 5

PROBLEM: How can the homemaking unit be designed with consideration given to outdoor living and dining?

APPROACH: The planners felt that one aspect of modern living, outdoor living and dining, had been consistantly neglected in homemaking school work. They believed that the addition of outdoor areas to the usual sewing, cooking, laundry, and living areas would help provide all-around facilities for a well-rounded program. They reasoned that nearly every modern house has outdoor terraces on which the living activities may be extended during permissible weather. Why shouldn't the outdoor terrace be used in connection with the homemaking unit?

SOLUTION: The scheme calls for a large terrace common to both the living room and the laboratory of the homemaking unit. A planting area gives the students opportunities to study the care of plants for the home. Equally important, this planting area helps make the homemaking unit a pleasant place for school living. Both the living room and the laboratory have access to the terrace. The laboratory contains a sewing center with garment and workbox storage, plus storage for cleaning equipment and fitting mirrors. It also contains a cooking center where there are four kitchen layouts, each with a different type of stove, cabinet, work surface, and sink. It includes, too, a laundry center with automatic washer and dryer. The homemaking unit also includes a bathroom, bed storage, and pantry.

Credits: This scheme was developed by Stanley Brown, Architect, for the Muenster School, Muenster, Texas. The Superintendent of schools was Weldon Cowan. Photography by Boyd Breeding.

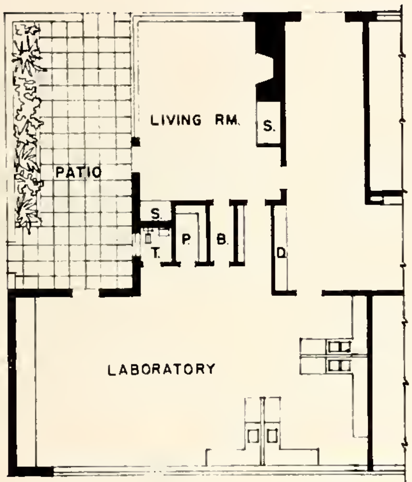
CASE STUDY 6

PROBLEM: Does the geometry of classrooms affect construction costs?

APPROACH: Because of the educational advantages of square classrooms, it was advocated by planners in the early stages of the project that the new additions have square classrooms instead of the conventional rectangular type. It was also advocated that improvements should be made over the conventional classrooms in the method for obtaining natural lighting. But the Board questioned the economic feasibility of deviating from the conventional classrooms. Members of the Board asked such questions as: Won't the square classrooms cost more because of the longer spans? Doesn't adding windows to improve the natural lighting increase construction cost? In order to answer these questions and many more, the planners made a cost analysis for three different classroom types, each having different geometric shapes but with similar construction and finish. For shapes see illustrations: Type "A" was designated as the conventional classroom. Type "B" was designated as a single-loaded corridor type set-up which the architects had already constructed and which had produced excellent natural lighting. And Type "C" was designated as a double-loaded corridor scheme with a dropped corridor. Type "A" classroom was only 23.5 ft. in width, while the other two were 27.5 ft. The floor areas of all three were the same. The analysis included a careful breakdown of all of the material in each classroom type. It was decided that the results of the analysis would determine which classroom type would be used for the two additions.

SOLUTION: The analysis revealed many interesting facts, but the three outstanding ones are: (1) Cost need not be a factor in the selection of rectangular versus square type classrooms where double-loaded corridors are used. (2) On the basis of total building costs, single-loaded corridor type buildings (Type "B"—closed corridors) conforming to ideal classroom daylighting would cost up to 10 per cent more than Type "A" and Type "C." (3) Type "C" proved to be the most economical, costing slightly less than Type "A." The planners, therefore, chose to use the Type "C" classroom. It was the most economical solution, and at the same time it allowed for very good natural lighting, much better than Type "A" although not quite so good as Type "B". So the solution was a square classroom with good lighting. The photograph above shows the final results of this kind of careful planning.

Credit: The analysis was made by the Office of Henry L. Blatner, Architect, in connection with planning the additions to the Grandview and Washington Irving Elementary schools, Catskill, N. Y., Superintendent of Schools was Paul E. Sellers.


LIVING RM.
S.
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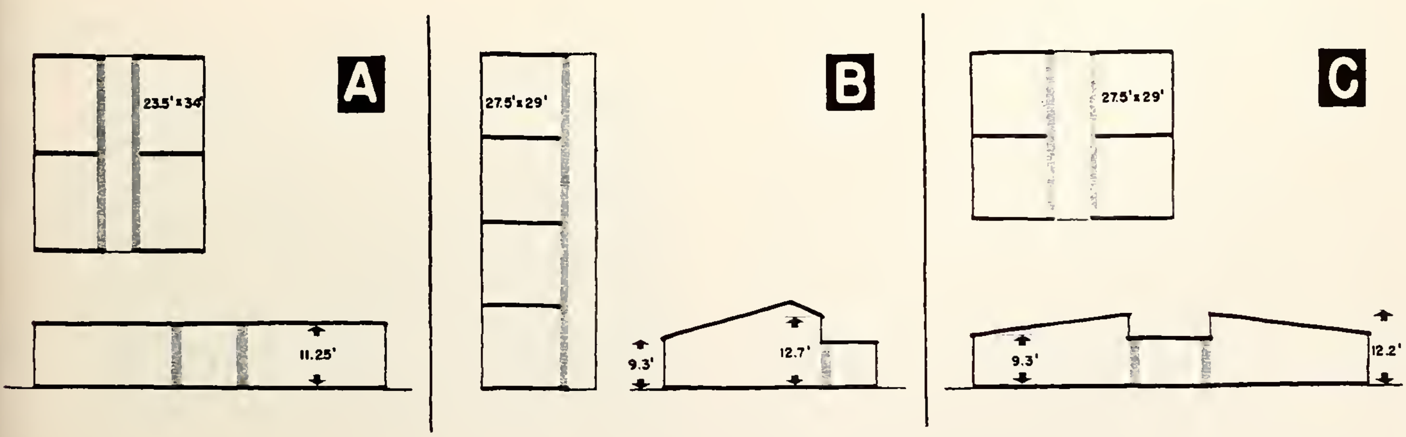
LABORATORY


A
23.5'x34'
11.25'
B
27.5'x29'
9.3'
12.7'
C
27.5'x29'
9.3'
12.2'

CASE STUDY 7

PROBLEM: Can improvements be made in the appearance and economy of hardware?

APPROACH: Most people think that hardware, like the weather, is something that they can do nothing about. But the planners of this project took the opposite attitude. They believed that the design approach could be applied to such small items as hardware, as well as to the general layout of the school plant. They were dissatisfied with the hardware that goes with a typical classroom door. They thought it cost too much. The planners thought, too, that the usual hardware required for classroom doors was cumbersome and uninteresting. What could be done? They decided that if possible the push-pull plate, the locking device, and the vision panel could be incorporated into one piece of hardware. They believed that it would greatly simplify and enchance the appearance of the door, with, perhaps, a reduction in cost. With a clear understanding of the problem concerning the operation of a classroom door, they approached the solution with the same thoroughness they had shown in developing the general layout, and arrived at a very logical and beautiful scheme.

SOLUTION: The results, as the photographs show, make sense. The planners designed a single piece of hardware with a four-fold purpose. It is a push plate; it is a vision strip; it is a door pull, and it is a lock. This composite piece of hardware is beautiful as well as functional. The door pull is recessed to avoid accident hazards. According to the planners, the cost of this special fixture was definitely lower than the cost of standard equipment.

Credit: This piece of hardware was developed by Ketchum, Gina, & Sharp for the Darien Junior High School, Darien, Conn. The Superintendent of Schools was Sidney P. Marland, Jr.

CASE STUDY 8

PROBLEM: Can corridors be used for educational purposes?

APPROACH: In the planning of this school, the architects were faced with the problem of providing a large multiple-use room, as well as 14 classrooms, on a limited budget. Here is another case of too much space and not enough money. The planners asked themselves, "With such a small pocketbook, can we afford space just to walk in?" "Why not put the corridors to work for education?" With this thought in mind, studies were made for enlarging the central corridor for possible use as a lunch room, an auditorium, a study hall, an exhibit hall, and a visual aids room. These studies developed into a scheme economical in every respect—and with every square foot of the school used for educational purposes.

SOLUTION: In the final scheme, the width of the all-purpose corridor was made approximately 32 ft. Classrooms were turned with the long axis perpendicular to the axis of the all-purpose corridor in order to reduce the length of the building and its resultant perimeter. Of course such a compact building lends itself to economy. A useful area was achieved without adding much to the total area and perimeter of the building. The interior spaces have adequate lighting and ventilation by properly placed plastic skylights and exhaust fans.

Credit: This school, the F. R. McKinley School, Farmington, New Mexico, was designed by Max Flatow-Jason Moore, Architects. The superintendent of schools who cooperated during the planning was La Moine Langston.

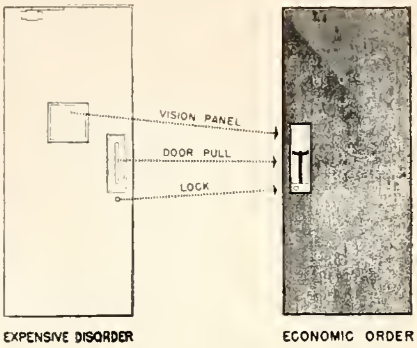
CASE STUDY 9

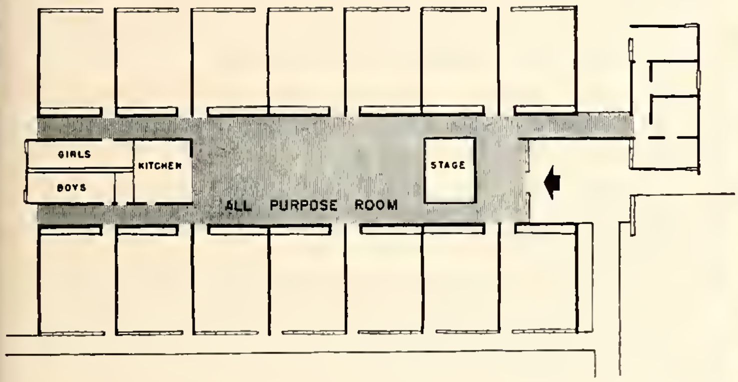
PROBLEM: What is a good way to provide easel painting in Kindergarten?

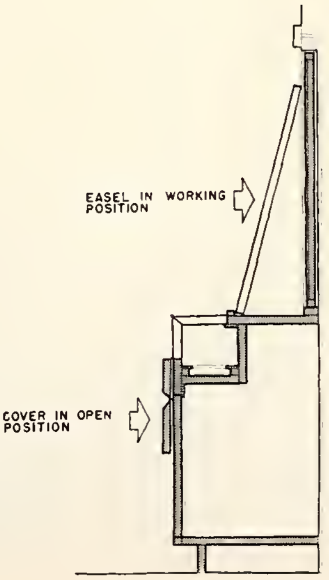
APPROACH: Easel painting in the kindergarten broadens the view, develops certain muscles of the arm, and stimulates coordination of mind and muscles. With that as a premise the planners gave particular emphasis to developing the easel as a teaching aid. They decided that the conventional portable easel was cumbersome, disorderly in arrangement, and consumed too much valuable storage space. They decided, too, that if portable easels were used, there would still be the problem of storing paints, brushes, water, and other supplies. After much study of the problem, the planners concluded that unlike advanced elementary art, kindergarten painting, being imaginative and creative, does not need to be done with a model. One of the school administrators, with the help of the kindergarten teacher, suggested that easels might well become a part of the wall. She pointed out that this would eliminate the confusion of transporting easels and painting materials to and from the storage room, and at the same time would use a minimum of storage and working space. This close cooperation between the architects and the educators resulted in a unique solution of the problem.

SOLUTION: The scheme illustrated above shows six of the ten built-in easel units—each with storage space for paints, brushes and other materials. For easy access, the front of the drawer in the unit and part of the shelf above the drawer are hinged, and a filler is inserted with holes the size of paint jars. The easels have a pin in each edge near the top and a slot in the small stile between the easels which allows them to swing out at the bottom to a slanting position for use. When not in use, easels are pushed back into closed position and serve as display tack boards, since the working surfaces are covered with cork.

Credits: This built-in was designed by Frederick Vance Kershner, Architect for the Robert L. Owen School in Tulsa, Oklahoma. Superintendent of Schools was C. C. Mason. Supervisor of Kindergartens and Primary Grades, Mary McClenaghan. Photography by Bob McCormack.


VISION PANEL
DOOR PULL
LOCK
EXPENSIVE DISORDER
ECONOMIC ORDER


GIRLS
BOYS
KITCHEN
STAGE
ALL PURPOSE ROOM


EASEL IN WORKING POSITION
COVER IN OPEN POSITION

CASE STUDY 10

PROBLEM: How can school corridors be planned for use other than just walking?

APPROACH: It was agreed by the planners that the customary locker arrangement did make the school corridor serve a multi-purpose, but none thought the long corridors lined with row upon row of lockers was the solution to the problem. Such arrangement produced an institutional atmosphere. But how could the corridors be broken up? What other ways could the corridor serve the children and their educational program? It was suggested that the corridors be broken up into small social areas—places where the students could talk over their problems. The planners also brought up the possibility of nooks connected to corridors for informal eating; such a scheme would surely be better than having one large and unbearably noisy dining hall. It was finally decided that alcoves off corridors had many possibilities. They could be used for "living spaces," for lockers, for eating, and for study. It was also agreed by the planners that such alcoves would make the corridors much more pleasant and eliminate that institutional feeling.

SOLUTION: The planners arrived at a scheme relating to an outside, but closed-in, corridor. Adjacent to the corridor is a large exterior social court of the school, so glass was used from ceiling to floor in the alcoves which over-looked the court. There are "U" shape locker arrangements on each side of the alcoves, for easy access from these social-study-eating alcoves. The alcoves are provided with tables and chairs to provide a "living" atmosphere.

Credits: Although this scheme was not used in the final plans, it did come up as one of many ideas during the development of the High School for Norman, Oklahoma, by Perkins-Will and Caudill-Rowlett-Scott, Associated Architects. Don Garrison, Superintendent of Schools.

CASE STUDY 11

PROBLEM: Can a school library be designed to serve the community as well as the school?

APPROACH: The planners made this assumption from the very start: Since the library was to be used by two different groups at the same time, the problem was simply one of human circulation, or of finding the best way to provide easy access to the stack area for both students and public, with minimum interference. It was also agreed by the planners that the students' usage would differ from the public's in that the students would need space for reading, while the public would need only enough space to check in and out books, plus a small space for catalogs and reference reading. The approach, therefore, was through solving a circulation problem of two different groups to a common element of space, the stack area.

SOLUTION: The final scheme provides for a stack room so situated that one librarian may serve both groups without direct contact between the groups. A small public lobby with a covered outside entrance gives the people of the community direct access to the library and eliminates any public use of the school halls. The covered area is large enough to double as a reading terrace, and may be used by both students and public. See photograph.

Credits: This scheme was developed by Stanley Brown, Architect, for the Muenster School, Muenster, Texas. The Superintendent of Schools was Weldon Cowan. Photography by Boyd Breeding.

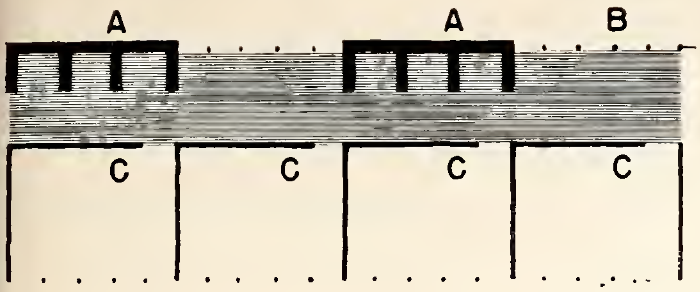
CASE STUDY 12

PROBLEM: Are pipe runs feasible in spaces other than underground pipe trenches in one-story, basementless, flatroofed buildings?

APPROACH: Pipe trenches have always been headaches to architects who have to fight to keep their projects within tight budgets. But to the architects of this project the pipe trench was an even greater headache. The site had a very high ground-water table, and the school board had a very low budget. The conventional pipe trench was both costly and impractical. It was another case where "necessity is the mother of invention." The architects, because of necessity, lifted the conventional pipe trench out of the ground and did it economically without sacrificing any teaching space.

SOLUTION: In search of a means of eliminating costly waterproofed, accessible, subfloor pipe trench, the planners arrived at a solution for running the pipe in overhead space. The scheme calls for an enclosed area above door height in which are located plumbing, heating, and electrical lines. This utility core also contains the unit ventilators. The entire utility space is accessible by removal of acoustical tileboard panels in the corridor. By using this scheme the planners solved the problem with an economical and very functional scheme.

Credits: The scheme was developed by the Office of Henry L. Blatner, Architect, for the Bethlehem Central Senior High School, Delmar, N. Y. The Superintendent of Schools was Hamilton Bookhout.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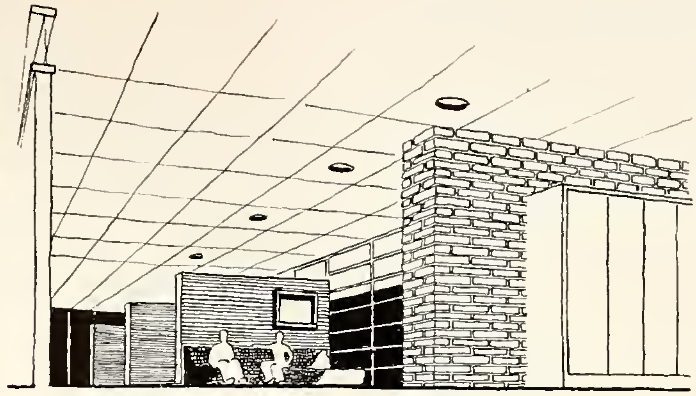
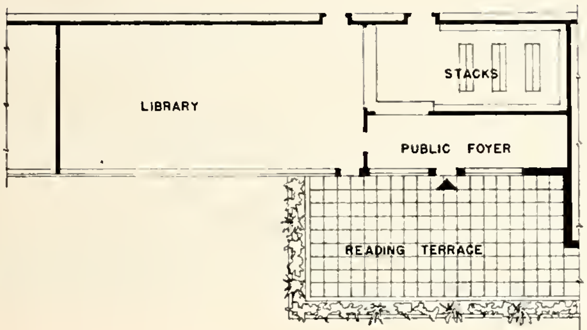
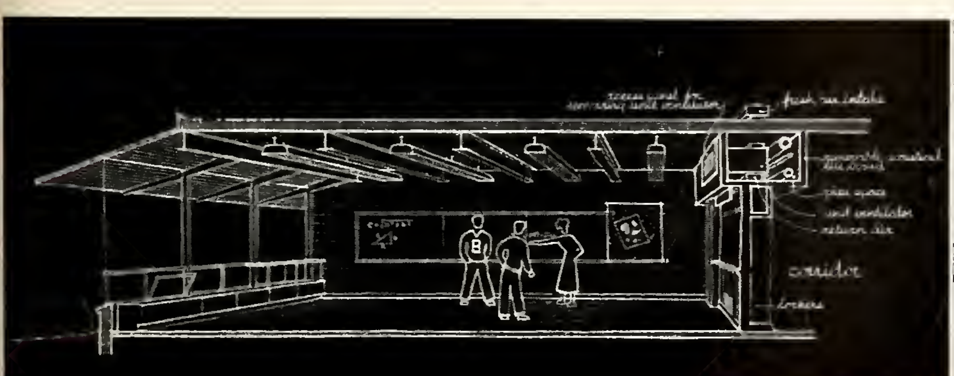



LIBRARY
STACKS
PUBLIC FOYER
READING TERRACE


corridor

CASE STUDY 13

PROBLEM: How can the design of corridors be improved?

APPROACH: In the early stages of this project the planners felt that the long, tunnel-like effect of most corridors could be improved upon. They believed, too, that if such improvements could be made, certain other advantages might be gained. The planners decided that the best device for cutting the appearance of the monotonous length of most corridors was to introduce some breaks in the long parallel walls. They considered the possibility of replacing the standard wall between the corridor and classroom with a storage wall of open lockers with glass above, opening the corridor into the classrooms and creating a feeling of spaciousness. Another scheme considered was the use of splayed walls at each classroom. These considerations and many more helped to produce the interesting and functional corridor described below.

SOLUTION: As the photograph and sketch show, the corridor is a much improved design over the typical school corridor. It is anything but monotonous. The locker cubicles arranged in a splayed pattern create a play of spaces which accents the classroom unit and at the same time diminish the length of the corridor. Since the cubicles are only slightly less than 5 ft. from the floor, the glass area above gives both the corridor and classroom a feeling of "flowing space." The use of glass not only has great aesthetic value, but also serves a very functional part in the classroom lighting scheme. Note on the sketch that the classroom doors are recessed from traffic flow. The planners believe too that the splayed wall scheme improves the acoustical qualities of both corridor and classrooms by eliminating the sound flutter. To further accentuate the play of space, the ceiling pattern and floor color of each classroom were carried into the corridor. The solution is a far cry from the conventional tunnel-like schoolhouse corridor.

Credits: The corridor was planned by Ketchum, Gina, & Sharp, Architects for the Holmes Elementary School, Darien, Conn. The Superintendent of Schools was Sidney P. Marland, Jr. Photography by Ezra Stoller.

CASE STUDY 14

PROBLEM: Can economy be achieved by plan arrangement?

APPROACH: The situation confronting the planners was to provide a simple, four-classroom school at minimum cost without sacrificing space. Because of high local labor cost and the inaccessibility of the site, building costs were extremely high. The architects decided, if economy was to be achieved, it would have to come from an economical layout. So the approach was made in developing the geometry of the school in such a way as to bring about savings in construction cost. The planners reasoned that outside walls cost more money than inside walls, and therefore a compact school with a minimum of outside walls would cost less than the conventional "strung-out" layout. They also reasoned that back-to-back plumbing was economical. With this kind of thinking the approach was to place all four classrooms back-to-back and to reduce corridor areas and plumbing cost.

SOLUTION: The final plan consists of four classrooms grouped together with the plumbing and heating in the center. The roof extends 8 ft. on all sides of the building, and forms a continuous outside corridor around the four classrooms. Two sides of each classroom serve as a common wall. Each classroom is a corner room with two walls of glass for improved lighting. This back-to-back classroom scheme is one answer to the question of how to get economical schools.

Credits: The scheme by Max Flatow-Joson Moore, Architects is a Primary School for Los Alomos, New Mexico. The Superintendent of Schools was Robert F. Wegner.

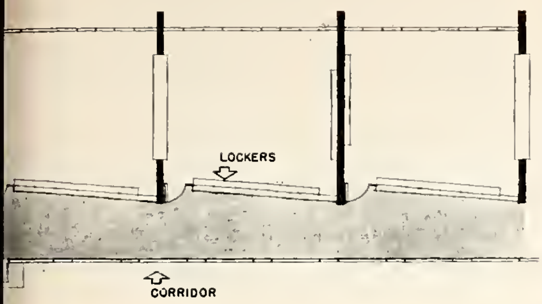
CASE STUDY 15

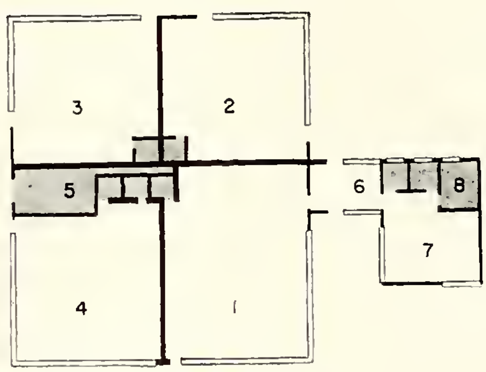
PROBLEM: Can a double-loaded corridor school have adequate natural ventilation as well as natural lighting?

APPROACH: The architects of this school had been confronted several times with the problem of providing natural lighting for double-loaded corridor arrangements, and they had arrived at such solutions as the dropped central corridor scheme, the monitor scheme, and the plastic bubble top-lighting scheme. But here they were confronted with solving not only the lighting problem, but also a ventilation problem. Because of site limitations, it was necessary that the axis of the building be oriented perpendicular to the prevailing breeze. Many schemes were considered. The one which the architects finally decided to develop was based on an arrangement providing cross ventilation by allowing the air to flow into the windward classroom and into and through the opposite classroom by going "over the corridor." Natural lighting was provided by a system of roof ridge sky lights. Because of the many variations of this particular scheme, the architects secured the services of the Texas Engineering Experiment Station to test these variations for determining the most feasible one to use. These tests were conducted by the use of models in an artificial sky to determine the lighting performance, and in a wind tunnel to determine the ventilation performance.

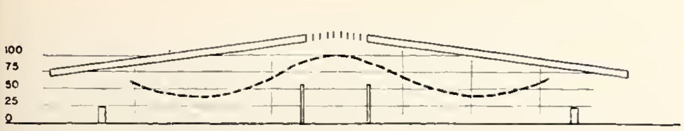
SOLUTION: The results of the tests of the Texas Engineering Experiment Station for the scheme used are shown here. Light is brought into each classroom from two sides—(1) through the exterior fenestration and (2) through the "light plenum hall" with skylights above. As the results indicate, the illumination in the classroom is high and evenly distributed. Results shown are based on a completely overcast (1000 foot-lamberts) sky. Ventilation results show even greater air flow in classrooms on the leeward side than in those on the windward side. The figures shown on the diagrams (right) are percentages of outside air flow. An open type egg-crate dropped ceiling in the central corridors extends into the classrooms to help control the air flow as well as control the glare caused by the sky lightings.

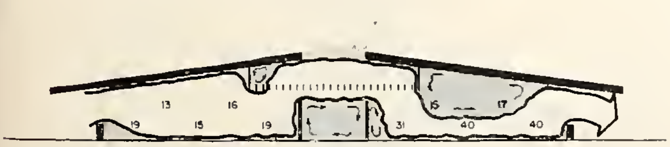
Credits: This school in Miami, Oklahoma was designed by the firm of Caudill, Rowlett, Scott, and Associates, who worked with R. C. Nichols, Superintendent of Schools.

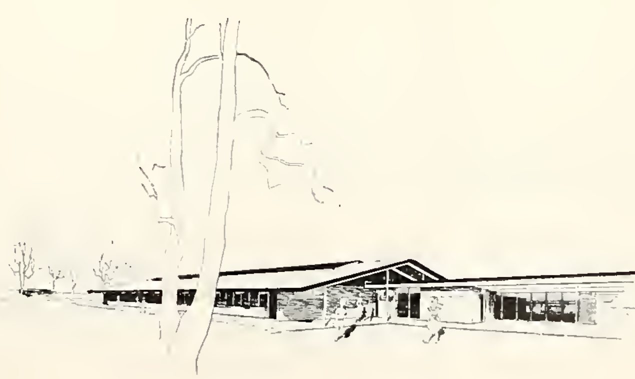




1 KINDERGARTEN
2 PRIMARY
3 PRIMARY
4 ELEMENTARY
5 HEATER
6 VESTIBULE
7 OFFICE
8 STORAGE







CASE STUDY 16

PROBLEM: How can adequate daylighting and natural ventilation be provided in extra width classrooms in a double-loaded corridor school?

APPROACH: Because of economy and of site limitation, the plan called for a double-loaded corridor arrangement, and because of the educational program, extra width classrooms were specified. The architects, therefore, were confronted with the problem of providing good lighting and ventilation under these two great limitations. As far as light was concerned, the architects set out to achieve a high level of evenly-distributed natural light. The Texas Gulf region's bright sky makes natural lighting feasible and according to the principal architect on this project, "the favorable Gulf Coast sky needs a sponsor." Therefore the approach was to take every advantage afforded by natural lighting means. Since the location of the school was in an area of high humidity, natural ventilation, too, was given great consideration. The architects concluded that a movement of air in the classroom was necessary for comfort during the hot school months, and made special effort to provide ample openings in the classrooms to facilitate this necessary air flow. In essence, the approach to solving this problem was simultaneous, in the direction of both natural lighting and natural ventilation.

SOLUTION: After a consideration of many schemes, the architects arrived at a solution which makes use of clerestory windows located approximately at the midpoint of each of the extra width classrooms. By the use of such a scheme, a high level of illumination was obtained (see distribution curve above). The architects reasoned that this "unilateral clerestory scheme was a very excellent solution because of the uniformity of sky conditions. In other words, light which streams through the windows come from only one portion of the sky, and the lighting distribution curve remains approximately the same regardless of changing sky conditions. The scheme calls for three openings in each classroom through which air will flow for the necessary cross ventilation. These openings are located at designations "a", "b", and "c" on the cross-section shown.

Credits: This school was developed in the office of Herbert Voelcker and Associates, Architects. It is the Woodcrest Elementary School, Port Neches, Texas, Cecil Yarborough, Superintendent of Schools.

CASE STUDY 17

PROBLEM: How can bilateral lighting and cross ventilation be obtained in a multi-story classroom building?

APPROACH: Students in multi-story classrooms have as much right to good natural lighting and proper natural ventilation as the ones in schools of one story. With this thought in mind the planners started studies for the development of a stacked classroom arrangement which would give bilateral lighting as well as bilateral ventilation. At first they tried a stagger floor scheme, but because of the complexity of framing, they abandoned it and tried others. A careful analysis of the several framing systems was made, with consideration given to (1) keeping all framing members to a minimum size, and (2) making allowance for maximum natural lighting. The approach, therefore, was through lighting and structures, with simultaneous consideration given to both.

SOLUTION: The final scheme produces bilaterally ventilated and lighted classrooms on the first two floors. Through a cantilevered corridor on the south (minus columns which interfere with light and breeze) maximum light and air floods into the corridors. The corridor, which is on the south, also acts as a sun shield for the classrooms. By use of large corridor glass walls, bilateral lighting from this glassed-in corridor is introduced in the first and second stories. In addition to this light received, the third story classrooms received additional light through high clerestory light, thus giving trilateral lighting.

Credits: The classroom building at the University of Oklahoma was designed by Vahlberg, Palmer, and Vahlberg, and W. T. Vahlberg, associated architects. University Architect Walter W. Kraft, Dept. of Physical Plant and Dean V. E. Monnet, Director of the School of Geology worked closely with the architects.

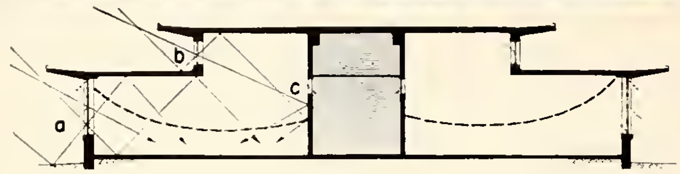
CASE STUDY 18

PROBLEM: Can toilets be designed to minimize control problems?

APPROACH: The problem of toilets-washrooms has always been one of irritation for teachers and school administrators. When the doors are closed, supervision is difficult. When they are open, there is a lack of privacy. Doors to toilet rooms receive the hardest treatment of any doors in the school plant and consequently have greater maintenance. The planners decided that the approach to solving the problem should be towards elimination of such doors. In the early stages of design it was found that a possible solution to the privacy problem was through the use of sight baffles, minus doors.

SOLUTION: In the final scheme, the planners made use of a baffled entrance. Both boys' and girls' toilet rooms, although arranged differently, include sight baffles which make doors unnecessary. See sketch (right). The water closets and urinals are completely shielded from view of students in the corridor. Note that the staff toilets are located between the student toilet area and the corridor. Such an arrangement helps to cut down the transmission of sound from the toilets to the corridor. Of course the elimination of banging doors also helps to eliminate extraneous sounds.

Credits: This arrangement was planned by Ketchum, Gina, & Sharp for the Holmes Elementary School, Darien, Conn. The Superintendent of Schools was Sidney P. Marland, Jr.


b
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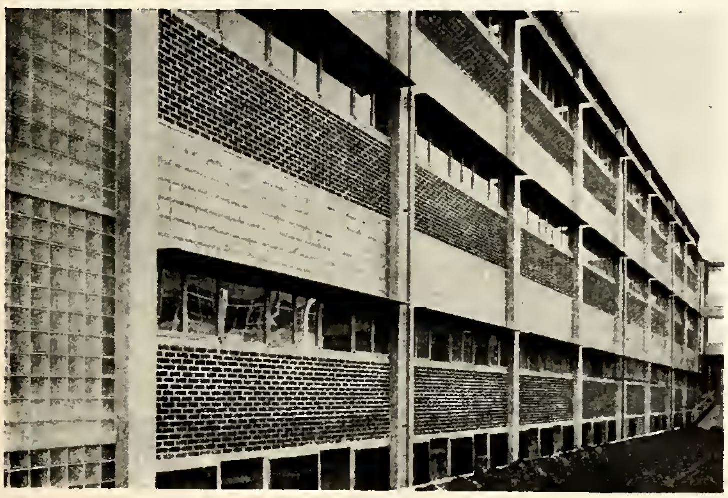
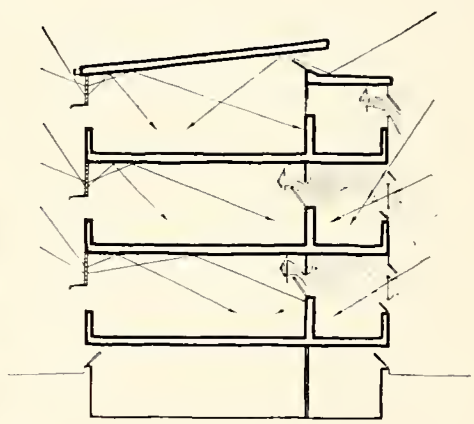
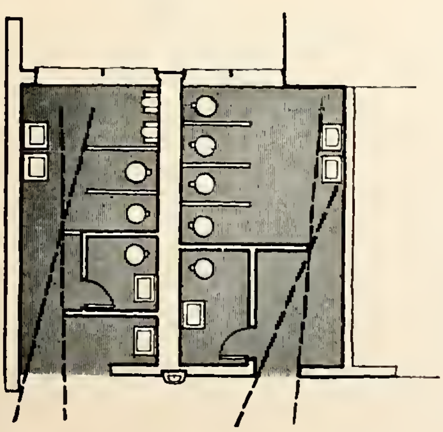
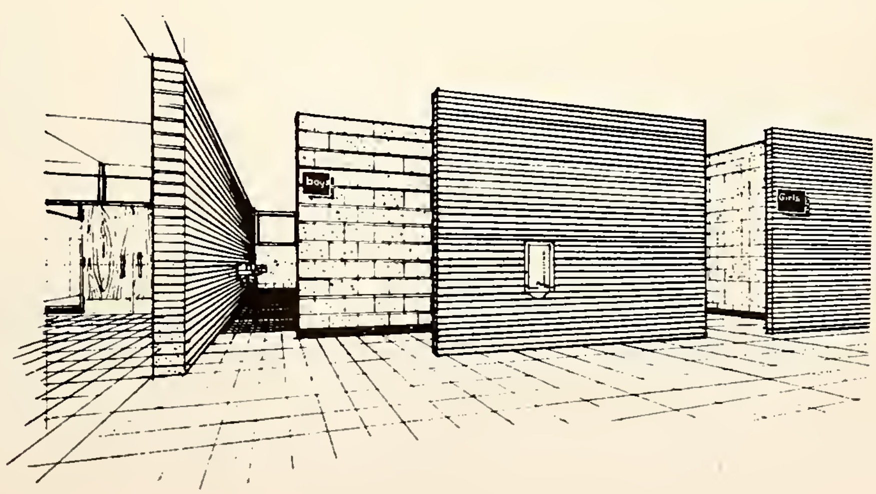







boys
Girls

CASE STUDY 19

PROBLEM: Can natural lighting be facilitated by plan-layout?

APPROACH: The planners felt that a possible solution to this problem might be through simultaneous consideration of outdoor classroom areas and classroom lighting. They believed that there must be an integration of the two. Since the standard double-loaded corridor was believed by the planners to be the most economical form for enclosed circulation, they decided to base the solution on this time-worn device, and at the same time to attempt improvements of its undesirable qualities, particularly to improve lighting. The approach centered around the development of a court scheme between classrooms, so that natural lighting could be brought into the classroom from two sides.

SOLUTION: The final scheme consists of a school having a partial double-loaded corridor. The school benefits by the economical aspects of the double-loaded corridor and the improved lighting of the single-loaded corridor. There is a central enclosed corridor with classrooms grouped in twos, back to back, and alternated on each side with open courts serving as outdoor classrooms. This, in effect, makes each classroom a corner room. Natural lighting is provided from two sides for each classroom. To reduce glare from the direct rays of the sun, corrugated translucent plastic is used above door height, with glass below on the sides opening into the courts.

Credits: This elementary school at Santa Rita, New Mexico was designed by Max Flatow-Jason Moore, Architects for the Kennecott Copper Corporation. G. J. Ballmer was Superintendent of Mines.

CASE STUDY 20

PROBLEM: How can a school be designed for effective community use?

APPROACH: The architects upon visiting the rural community of Industry, Texas for the first time had this to say: "Industry's school building problem is unique. Where most schools function only to house the educational program, Industry's proposed schoolbuilding must, and should, facilitate the cultural, recreational, and social activities of the community as well. The new Industry School must be more than a school; it must be a community center, a recreational hall, a town hall, a library, or the Capitol of the Community.[11] The approach for solving the problem was made with this in mind. A careful analysis of community needs indicated that the new school would be about the only major building of importance within a radius of ten miles. There was not a single movie-house in the entire district, much less a community hall. Community suppers, barbecues, movies, and even wedding receptions were held in the old school plant. The new school plant had to be half school, half community center. Because of the mild climate (and probably also limitation of space) many of the activities were held out-of-doors; so the planners decided that one of the best ways to provide lots of economical space would be through the use of roofed terraces. One problem that came up during the planning stage concerned the size of the all-purpose room. The school board felt that provision should be made for all the people who flock to graduation exercises and the Christmas party. There wasn't enough money to build such a large room; therefore the planners considered the possibility of using the covered terraces as over-flow from the all-purpose room.

SOLUTION: The design of the school includes spacious, protected terraces to be used both by children during school day as play sheds and by the public as social terraces. A skylight provides bilateral lighting for classrooms, as well as light for the terraces and all-purpose room. Large sliding glass doors open up to let the activities of the all-purpose room be extended onto the terrace. This flexible arrangement is particularly adapted to the graduation program.

Credits: This school, designed by Caudill, Rowlett, Scott & Associates, is located in Industry, Texas. County Superintendent of Schools, George W. Hill.

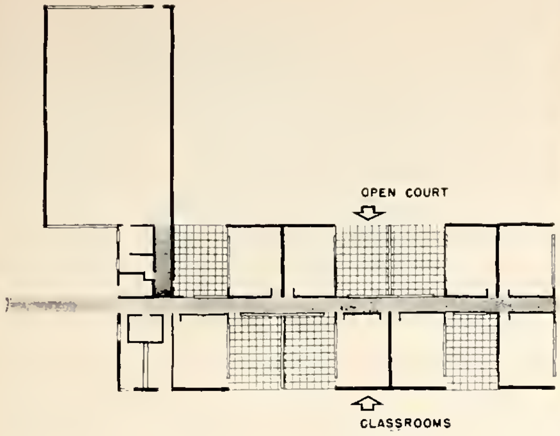
CASE STUDY 21

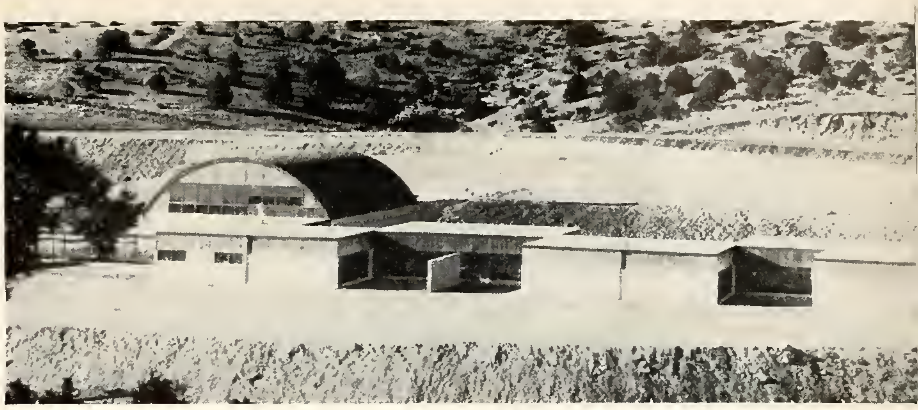
PROBLEM: What are some architectural techniques of making multi-use of space?

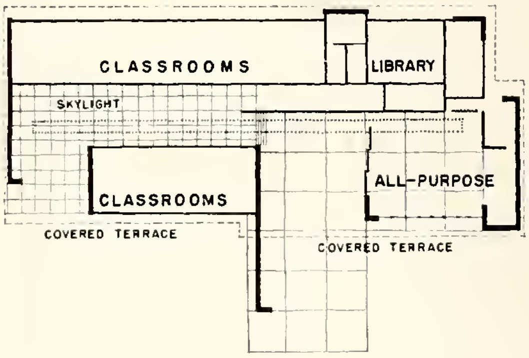
APPROACH: Here is a situation in a large metropolis where land is at a premium. The site for the new school must, for economic reasons, be extremely small, only 200 ft. by 100 ft. Because of the concentrated housing around the school site, approximately 2,750 children will attend the school. The planners were faced with these problems: (1) how to provide playground area on such a small site, (2) how to design a building to house such a large enrollment on such a small site. The planners decided that the building must be designed for multiple use of space. There was no place for a large playground area because the building itself would have to cover the entire lot; so they reasoned that the playground must be in the building. Of course the situation called for a multistory building, despite educational disadvantages. The planners, however, considered that these disadvantages could be minimized if the school could be zoned for the various age groups—perhaps by putting an assembly room on each floor. But then the planners were confronted with the problem of space limitation. There simply was not enough space to have assembly rooms on each floor. Therefore the entire thinking behind the approach to the design of this school had to be in terms of multiple use of space.

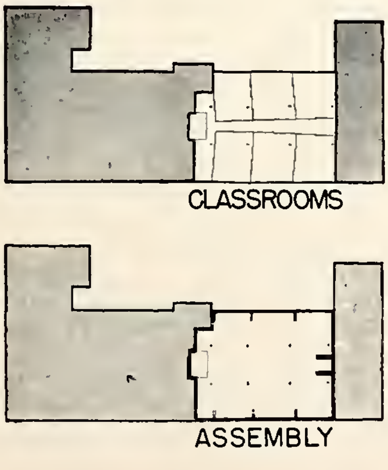
SOLUTION: The final plan consists of a multi-story building covering the entire site. According to the architects, the "first story is divided into boys' and girls' playgrounds with asphalt floors. The pupils' closets are all placed in a courtyard at the rear of the school." The solution, therefore, is to utilize the ground floor for recreation. In order to achieve decentralization of this huge school plant, provisions are made for assemblies on each of the second, third, and fourth floors. Each of these floors "is divided off into 16 classrooms, six of which comprise the assembly room." Sliding partitions make it possible for the entire area, covered by the six classrooms and their connecting corridor, to be thrown open for assembly purposes. See sketch. Here is a case of flexibility at its best. This school has nearly one-half of its space for multi-purpose use.

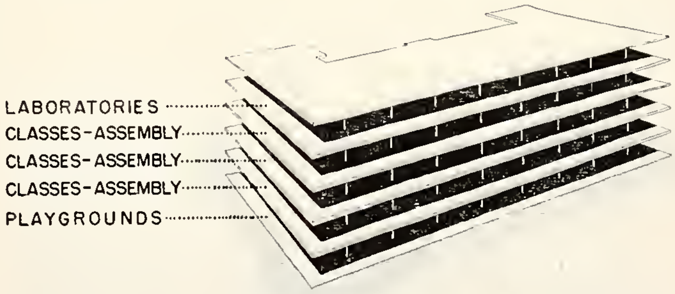
Credit: The new school located at Edgecombe Avenue and 140th, New York City, was designed by C. B. J. Snyder, Architect, in 1891. This report is taken from June 1, 1895, issue of Architecture and Building, a weekly. For illustration of exterior, see Illustration No. 13.











MULTI-STORY ZONING

CASE STUDY 22

PROBLEM: Can combinations of spaces be used effectively in small community schools?

APPROACH: This situation calls for the planning of a small church school in a small community. As in many other communities of this nature, the school serves many purposes, from educating the children to providing space for meetings of the ladies' sewing groups. Also as in many other communities, money for building purposes was very limited. The architects concluded that the new building should be designed for full community use as well as maximum educational use, with every square foot coming into play for the school or the community or both. It appeared that possibly the most logical solution would be a combination room which could serve as many functions as possible—even the functions of a classroom.

SOLUTION: After considering a great number of possible schemes, the one shown (right) made the most sense to the planners. It proved to be economical as well as practical from the standpoint of education and community use. For the most part the scheme is an enlarged classroom with a stage at one end. The shape of the plan was determined by the desired circulation flow as well as the various functions which the room is to serve. Here are some of the functions of this multiple use space: (1) as a library (on stage), (2) as an assembly area, (3) as a dining hall, (4) as a classroom (note folding partition), (5) as a recreational room, and (6) as a study area. All of these can serve both students and public. To top all of this, because it is a parochial school it also serves for worship purposes.

Credits: This is the Zion-Lutheran School, Fairmont, Okla. designed by Vahlberg, Palmer, and Vahlberg, Architects. Credit should also be given to John H. Nobis, Ted C. Maehr, E. J. C. Eggers, Ernest Holle, and Eno G. Lohse, who not only served on the building committee, but also actually helped build the school. Photography by A. Y. Owen.

CASE STUDY 23

PROBLEM: Can a two-story school be planned for high level, evenly distributed natural lighting as well as a one-story school?

APPROACH: The architects were confronted with this problem when the school district adopted the clerestory (high windows over midpoint of classroom) type of construction on several elementary schools, and could see no reason why it should not be used on the proposed two-story high school. The architects and the school board members alike reasoned that the high school pupil had as much right to adequate lighting as the elementary school pupil. After many schemes were investigated, the planners agreed on the scheme of stacking a single-loaded corridor floor on top of a double-loaded arrangement. By zoning the large teaching areas, such as laboratories and lecture rooms, on the upper floor, the planners found that the scheme was feasible—every room could be flooded with high-level, evenly-distributed lighting.

SOLUTION: The plan, as developed, provides laboratories in 32-ft. widths ("B" on sketch shown) on the upper floor, and general classrooms ("C" on sketch shown) on the lower floor of approximately 28 ft. in width. The corridor on the upper story (designated as "A") is located on the west and offers sun control for the laboratories. Overhangs on all other openings control the sun with the help of shades installed on the lower part of the window openings. In this case the second floor accounts for one fifth of the total area of the high school. Although this arrangement may appear at first to have a complicated structure, the architects' construction cost was comparatively reasonable, and the scheme solved the problem.

Credits: The scheme was developed by Herbert Voelcker and Associates, Architects, in connection with the planning of the Port Neches High School, Port Neches, Texas. Superintendent of Schools, D. T. Craver.

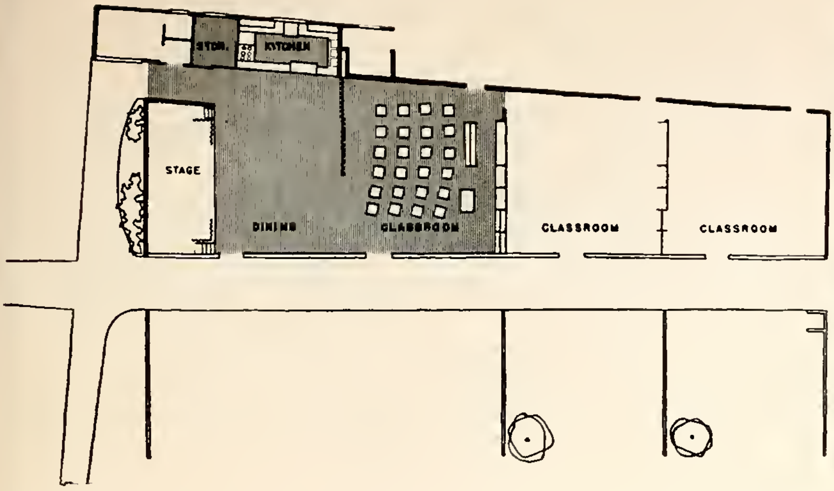
CASE STUDY 24

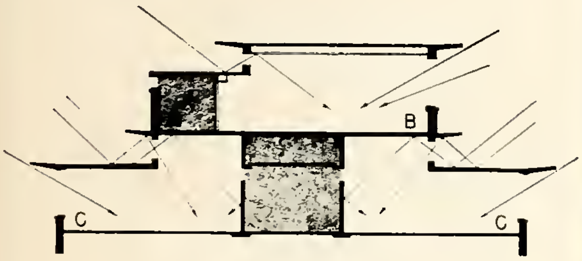
PROBLEM: Can corridors be made to serve purposes other than walking space?

APPROACH: During the planning stage of the development of a college student union building the architects arrived at what seemed to be a logical building layout which included a long connecting corridor. These questions of course came up. Can such a large area be justified for walking only? Could such space be used as an exhibit hall? Or maybe a lounge? And would such a multi-function corridor be economically feasible? Many studies were made in an attempt to find answers to these questions. The problem was approached from all directions with chief considerations given function and economy. Such an approach resulted in a very beautiful as well as functional solution to this problem.

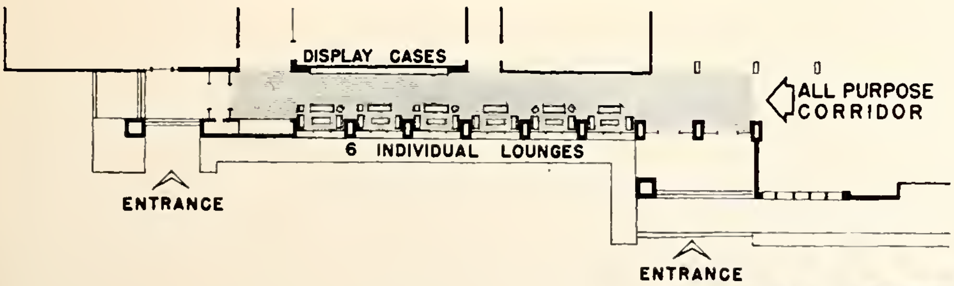
SOLUTION: The above photograph and diagrammatic layout show the result—a truly multi-function corridor. By widening the corridor a few feet, the architects were able to include several small lounges. They argue that pupils like to gather at times in small groups, and these individual lounges afford such opportunity. Each lounge, with glass from floor to ceiling, opens out onto a beautiful landscape. In addition to good views, the pupils have excellent lighting conditions, both natural and artificial. On the opposite side of this multi-use corridor, referred to as "the promenade" by the pupils, there are continuous glassed-in display cases for exhibits of paintings, small sculpture or other educational materials. The building now has had full use, and this multi-purpose hall is one of the most popular spaces in the building—enjoyed by pupils and faculty alike.

Credits: The building is the Memorial Student Center on the campus of Texas A. & M. college, College Station, Texas. The architect was Carlton W. Adams, Sr.


STOR.
KITCHEN
STAGE
DINING
CLASSROOM
CLASSROOM
CLASSROOM


B
C
C


ARCHITECTS


DISPLAY CASES
ALL PURPOSE CORRIDOR
6 INDIVIDUAL LOUNGES
ENTRANCE
ENTRANCE

CASE STUDY 25

PROBLEM: Can open-type corridors be used successfully in the northernmost areas in the United States?

APPROACH: Although climates may vary, the problem of economy is common to all parts of the country. Here the architects reasoned that the substitution of unheated outside corridors for heated interior ones would result in a worthwhile saving. Encouraged by Wilfred Clapp of the Michigan State Department of Public Instruction, they sought to develop a corridorless school. They felt that too much emphasis had been placed on complete protection from the elements at all times—even for schools in Michigan, where temperatures are extremely variable. They reviewed the Air Force research studies, which revealed that people are more hardy than they had been generally considered, and that resistance to disease is lowered more by prolonged exposures than by sudden changes of temperature. After thorough study of various methods of eliminating corridors and providing other means for normal circulation under extreme conditions, the planners arrived at this scheme.

SOLUTION: The result is one of the first schools in the extreme northern part of the country to have no interclassroom corridors. As in many California and Texas schools, a covered walk has been provided, but this Michigan school went them one better by providing only a minimum canopy over the outside walk. This canopy is economically made of a steel pipe frame to which has been screwed a cover of translucent corrugated plastic. The covered walk is designated "A" on the diagram above. The building mass, "B" contains the classrooms, and "C" is the all-purpose room. The scheme employed here allows students to disembark from buses under shelter and proceed to any part of the building group.

Credits: The scheme, developed in the office of Gordon Cornwell, Architect, concerns the Drummond Island Elementary School, Drummond Island, Michigan. Wilfred Clapp, Consultant.

CASE STUDY 26

PROBLEM: Can corridor space be used for purposes other than circulation?

APPROACH: During the planning stages of this high school these premises, among many others, were set up: (1) the primary function of good school design is to create a pleasant, comfortable, and inviting atmosphere in which learning can take place; (2) particularly, boys and girls of high school age need and deserve pleasant surroundings; (3) since corridors of high schools occupy such a great percentage of the total floor space, special attention should be given to the design of the corridors; (4) if a school building is to be educationally efficient, the greatest possible area should be of direct use in the educational program. These four premises were used in the development of a corridor-lounge scheme. The planners reasoned that, properly treated, corridors could do much to lend to the atmosphere and at the same time provide space for many activities in addition to circulation.

SOLUTION: The corridor-lounge scheme as presented here results from consideration of the four factors mentioned above. The scheme calls for a section of the main corridor immediately adjacent to the library to be used as an informal lounge and reading area. Large sliding plate glass doors between the library and the corridors provide, in effect, an extension of the library. The lounge as an extension of this library also provides a very important space for small community groups, such as P.T.A. or small student groups such as the Student Council, in an environment which encourages informal education. This fresh solution stems from a thorough knowledge and understanding of youth by planners who, when planning school buildings, start with the school child and not with a stock floor plan.

Credits: This scheme was developed during the planning of the Newton High School, Newton, New Jersey, Joy C. Van Nuys, Architect, Superintendent of Schools, Stuart R. Race, Consultant, Walter D. Cocking, Photography by Douglas Meaney.

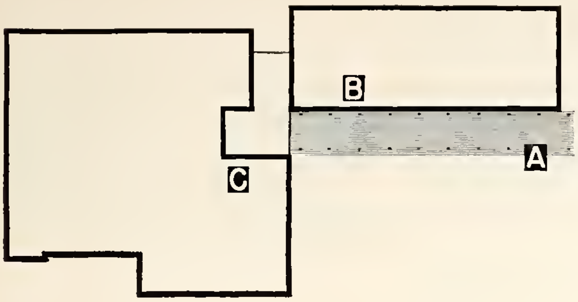
CASE STUDY 27

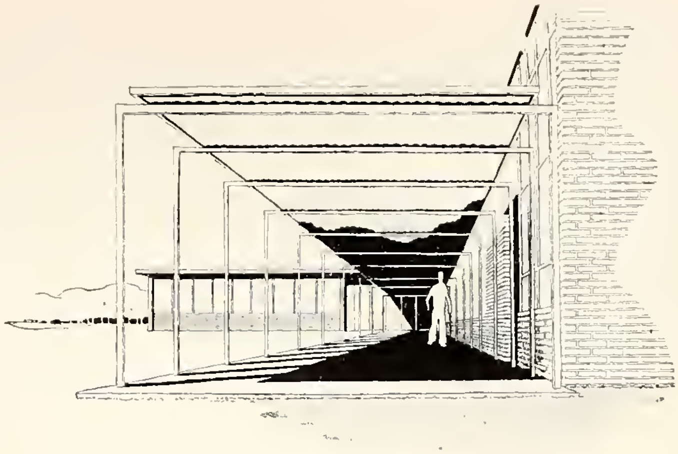
PROBLEM: Can "back-to-back" classrooms be designed for proper natural lighting and natural ventilation?

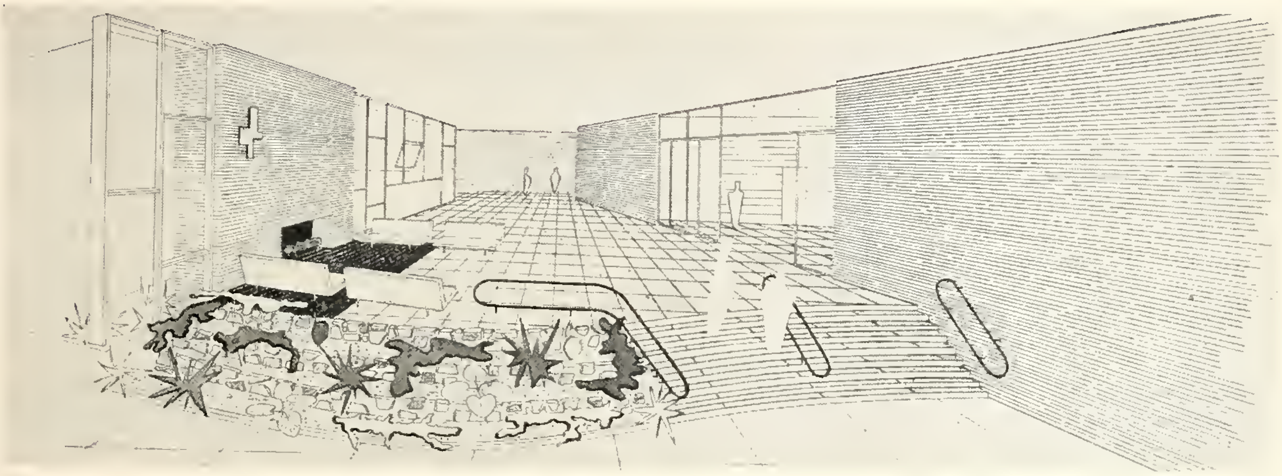
APPBOACH: In this case the site was extremely small. A very compact plan would be required for the proposed high school addition. After many studies, the architects finally agreed on a "back-to-back" classroom scheme. Next they faced the very difficult problem of how to provide good natural lighting and proper ventilation. They had had a great deal of experience in using the finger plan technique, where single rows of classroom wings spread apart to allow light and air to enter each room, but here the situation was quite different. In an attempt to get lighting and ventilation equal to that offered by the finger plan, the architects sought the council of the staff of the Texas Engineering Experiment, particularly Bob H. Reed, E. G. Smith, and Ben Evans. With them the planners arrived at a very unique, but logical, scheme, which was tested in the model testing laboratory of the Station.

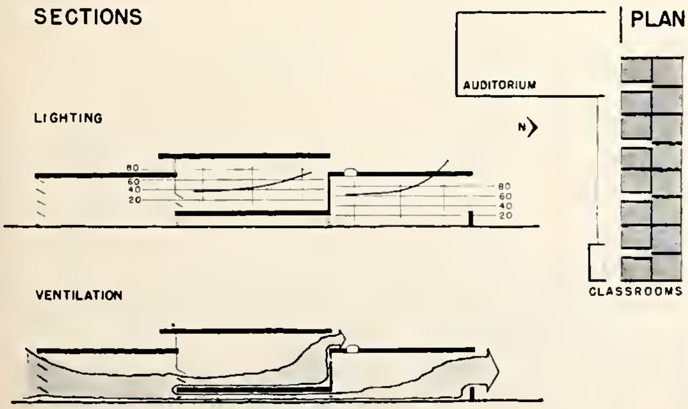
SOLUTION: The solution of this problem provides for four major functions: (1) the breeze from the south (in this case) flows into the all-purpose corridor through the south classrooms, and out the north clerestory windows; (2) the breeze also flows into the north classrooms from the same corridor through a duct under the floor of the south classrooms and out the north windows; (3) light enters the south classrooms from clerestory windows on two sides of the classrooms as well as through large glass openings on the corridor; (4) light enters the north classrooms through the north windows and through plastic bubble skylights situated near the inside wall. Sun control is provided by overhangs. The architects were particularly pleased with the possibilities of low sound transmission through the long under-the-floor duct. Note on small sketch that access to the north classrooms is provided with small finger corridors. The results found by the Texas Engineering Experiment Station are shown at the right.

Credits: This high school addition in Guymon, Oklahoma was designed by Caudill, Rowlett, Scott, and Associates, Architects-Engineers. Superintendent of Schools was George Spenner. Bob Reed, E. G. Smith, and Ben Evans of the staff of the Texas Engineering Experiment Station helped in the development of the lighting and ventilating scheme.


B
A
C






SECTIONS
LIGHTING
80
60
40
20
80
60
40
20
VENTILATION
PLAN
AUDITORIUM
N
CLASSROOMS


HIGH SCHOOL FOR GUYMON OKLAHOMA

CASE STUDY 28

PROBLEM: When "committee" or "activity" space is specified to facilitate the educational program, what is the best way to work it into the classroom layout?

APPROACH: The problem here concerns grades four through eight. It was decided that for this age group committee or activity rooms were needed adjoining each classroom. Such spaces give the youngsters real opportunity to work in small groups on problems connected with their everyday class activities. But such spaces must be planned for convenient supervision by the teacher, and sound-controlled so that the noisy work going on there will not disturb the quiet work in progress in nearby areas. Therefore it was decided that the activity space would be partitioned off from the classroom, but with a glass partition which would permit the teacher to keep an eye on the proceedings.

SOLUTION: The planners developed two different activity room arrangements: (1) a two-room suite for each classroom, and (2) a single combination suite shared by two classrooms. This was accomplished by providing suites of activity rooms separated from the classrooms by sound-resisting partitions fitted with large plate glass windows, and installing acoustical tile in the activity rooms themselves. Two of the classrooms have two activity rooms each, and four classrooms are arranged in pairs, each pair sharing space 9 ft. 6 in. wide and 28 ft. long which can be divided into two rooms 9 ft. 6 in. wide and 14 ft. long by means of a folding door. When the activity space is so divided, two groups can work at the same time, each under the supervision of its own teacher. A variation of the scheme (actually carried out in this school) is to put the laboratory and workbench in the classroom proper.

Credits: This arrangement is a part of the College Township School, Linn County, Iowa. The architect was William Jay Brown working with Superintendent of Schools Sam Wiley, County Supt. Walter Shopp and Dan Cooper, Consultant.

CASE STUDY 29

PROBLEM: Do storage-wall cabinets make satisfactory dividing partitions between classrooms?

APPROACH: Much can be gained in school design by studying other building types such as stores, factories, and homes. During recent years particular advancements have been made in the home, one of the outstanding advancements being the so-called storage-wall. The planners of this school saw great merit in adapting the storage-wall idea to the school. Such a scheme made good sense. A classroom partition, if properly designed, could incorporate all of the necessary facilities, such as a sink, wardrobes, storage, and files. Such a scheme, the planners concluded, would result in savings by consolidation of parts, usually installed in different parts of the room, into a compact partition grouping. They also reasoned that considerable flexibility could be obtained by having the units built in standard sizes, making them interchangeable for future rearrangement.

SOLUTION: The solution is illustrated by the diagrams above. Note that by facing some of the units into one classroom and some into the adjoining classroom, it was possible to have the sink and wardrobe units in the rear of the room, where, according to the architects, they logically belonged. Note also that the teacher's storage, coat closet and record files are in the front of the classroom—again a logical location. This scheme calls for the backs of the cabinets to be covered with either chalkboard or corkboard as desired. A wood stud partition with acoustical tile on both sides is used to fill the space from the top of the cabinets to the ceiling. In actual practice the storage-wall partition proved very satisfactory as far as sound transmission was concerned. Cost comparisons indicate that this solution (the storage-wall partition) is no more costly than conventional construction, and might even result in some savings.

Credits: This scheme has been used in the Hillandale Elementary School located at Montgomery County, Maryland, Edwin W. Broome, Superintendent of Schools; Richard E. Carpenter, Assistant Superintendent in charge of Supporting Services. McLeod and Ferrara, Architects. Engelhardt, Engelhardt, & Leggett, Educational consultants.

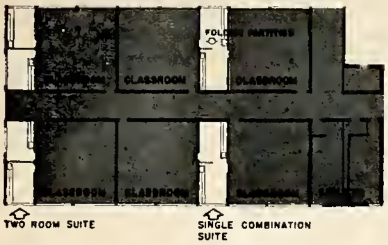
CASE STUDY 30

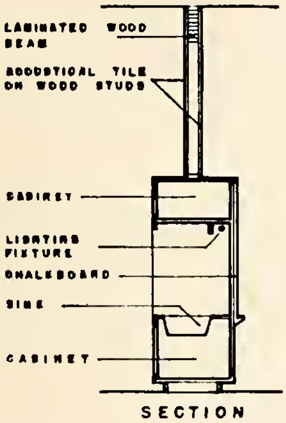
PROBLEM: How can cross-ventilation and bilateral lighting be provided in double-loaded corridor classroom arrangements?

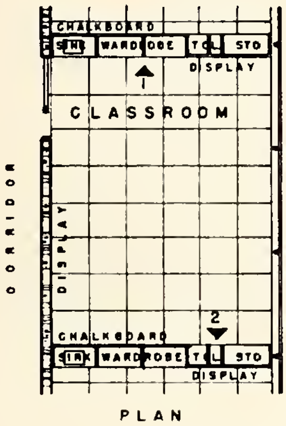
APPROACH: The planners of this school during the early stages of design had much debate on the merits of the double-loaded corridor classroom layout. Particularly they were concerned with the comparative performance of the double-loaded corridor and the newer single-loaded corridor finger plans. The planners concluded that the chief advantages of the more compact double-loaded corridor school are: (1) circulation is much shorter because there is only half as much corridor; (2) heating, plumbing, and electric mains and feeders to classrooms would also be shorter; and (3) the locale (Grandview, Washington) because of extreme weather would require enclosed heated corridors. But they also found that the chief disadvantages of the customary double-loaded corridor layouts are: (1) the window walls are generally brightly lighted and the corridor walls contrastingly dark; (2) such conditions become aggravated by the trend toward larger and more square classrooms; and (3) classrooms on double-loaded corridors usually have poor natural ventilation and the characteristics of the area makes adequate ventilation very desirable. The architects next decided that their approach would be to try to hold the advantages of the double loaded corridor arrangements and eliminate the disadvantages. Many schemes were tried. The architects secured the services of the Texas Engineering Experiment Station to test some of them for predictions of both lighting and ventilation. Tests results helped the planners to determine what the most logical solution would be.

SOLUTION: The scheme selected for final development consists of a dropped corridor roof with clerestory windows above the corridor walls. These high windows add materially to the lighting of the ordinary unilateral setup. See diagram (right). The dotted distribution curve shows the lighting performance (based on a 1000 foot-lambert sky) minus the effects of the clerestory. The solid shows the effects with the clerestory. The architects contend that this cross light helps to eliminate shadows. Tests also show that the clerestory windows facilitate cross ventilation. The extension of the roof helps to build up pressure to cause air to flow into the leeward classrooms.

Credits: This scheme was developed by John S. Villesvik, Architect, for the Grandview School District, Yakima County, Washington. The Superintendent of Schools was Clorence McClure.


FOLDING PARTITION
CLASSROOM
CLASSROOM
CLASSROOM
CLASSROOM
CLASSROOM
TWO ROOM SUITE
SINGLE COMBINATION SUITE


LAMINATED WOOD BEAM
ACOUSTICAL TILE ON WOOD STUDS
CABINET
LIGHTING FIXTURE
CHALKBOARD
SINK
CABINET
SECTION


CHALKBOARD
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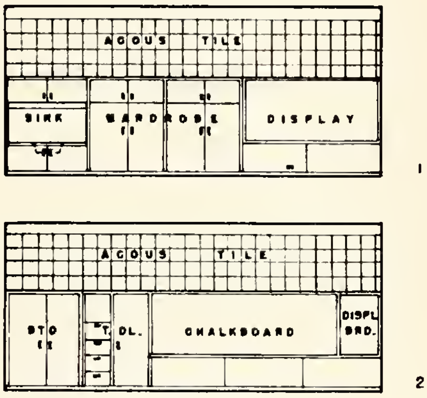
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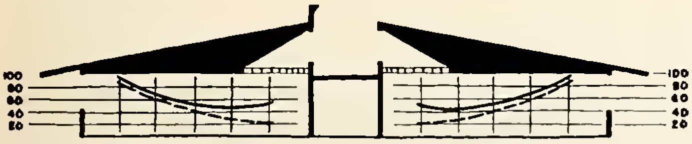
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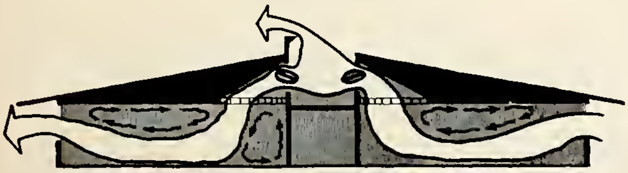
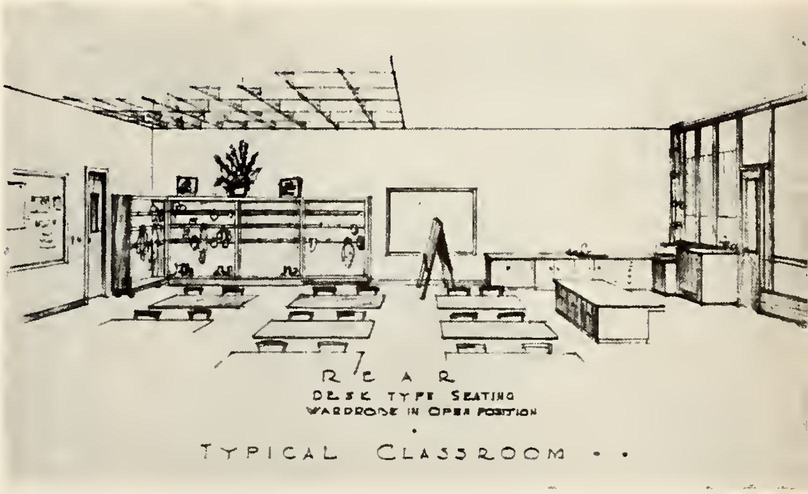



REAR
DESK TYPE SEATING
WARDROBE IN OPEN POSITION
TYPICAL CLASSROOM

CASE STUDY 31

PROBLEM: How can construction be speeded up?

APPROACH: This problem grows out of the Great Northwest where there the weather is wet but not cold enough to halt construction. In this particular case the architects believed that construction could be speeded up "if we could get a roof on quicker" in order to give the workers protection from the rains as soon as possible. "Build the roof first and you will give the workers a work shop in which to build" was the thinking of these planners. Working under cover, they reasoned, cuts down construction time, which in turn cuts construction costs. In order to translate these thoughts in terms of building plans, the architects started to work on the development of a school which would have no loadbearing walls. Their plans evolved into a scheme in which the roof rested on 4-in. pipe columns.

SOLUTION: The proof of this pudding is in the letting. Bids were comparatively low. Apparently the contractors realized the savings of the "work shop" scheme. Construction was started in the worst part of the winter (November 1949) and the roof was up within six weeks. See construction photograph above. Notice that even the floors are yet to be poured. It is interesting to know that since radiant heating was used in the concrete floor slab, there was heating available to the workers before the interior walls were started. By extending tarps out from the roof, all masonry, glass block, and window work could be carried on with practically no delay because of bad, wet weather. However, the architects believed that perhaps the crafts who appreciated the early roof the most were the electricians and plumbers because of the nature of their painstaking work. This "putting the roof on first" scheme unquestionably has some merits in climates where rain presents a construction problem

Credits: This scheme of construction was developed in the planning of the Washington School in Centralia, Washington by William A. Johnson and Associates, Architects-Engineers. The Superintendent of Schools was William Bloom.

CASE STUDY 32

PROBLEM: Can low budget gyms be lighted effectively by natural means?

APPROACH: An economical framing system for a 110-ft. span compatible with the controlled source of natural light emerged in the early design stages as being the dominant problem. The planners found by cost analysis that considerable savings in volume and exterior enclosures would be realized by the use of arched rib primary framing in lieu of the customary truss and column construction. They also investigated the effects of the ceiling shape on room activities and found that the curved ceiling did not in any way hinder such activities as basketball, volley ball, indoor tennis, and badminton. In sectional plotting of these activities it became obvious that the arched roof structure would satisfy dimensional requirements of these games, and at the same time eliminate columns, reduce cubage, and offer a satisfying architectural expression. Of course, the next problem confronted by the architects was how to light the gym. They felt that lateral lighting left much to be desired as far as distribution goes. They reasoned that the best lighting should be in the center of the courts, not in the spectators' bleachers. For these reasons, they considered overhead skylights. They knew that although overhead skylights gave excellent distribution, but that the excessive brightness must be shielded; so a scheme of brightness-cutting louvers was devised. The next step taken by the architects was to send their basic plans to the Texas Engineering Experiment Station for testing in the Model Testing Labs. The results of the experiment were very gratifying.

SOLUTION: The final solution consists of a glue-laminated arch of a deceptively small area to span the playing floor. Eight inlets are provided by two continuous slots covered with translucent corrugated plastic. A system of suspended louvers shields the bright plastic surface from view and scatters the light across the playing floor. Above the ceiling is space for concealing mechanical runs and heating units. This scheme buys economical space and excellent lighting at the same time.

Credits: This high school gymnasium for Davenport, Washington was designed by J. Lister Holmes together with McClure, Adkison & MacDonald, Architects and Planning Consultants. The Superintendent of Schools was John Hulvey.

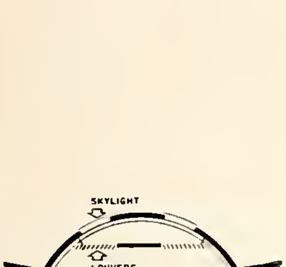
CASE STUDY 33

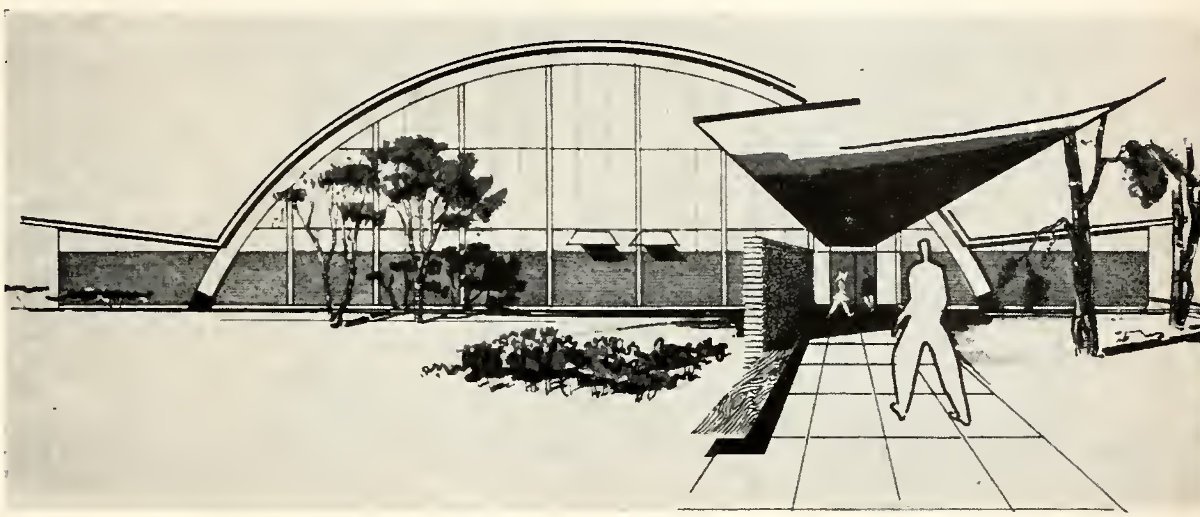
PROBLEM: What is a feasible way to protect low glass area in elementary school playrooms without marring the beauty of the structure?

APPROACH: The architects of this project, noted for their warm and friendly school plants, believe that even the playroom can be made beautiful as well as practical by generous use of glass to bring the outside inside. They contend, too, that the cheer of sunshine and light mixes into a friendly game of basketball. But bouncing balls and bounding players are to be reckoned with, and some means of protecting the glass and visually defining the limits of the room to active players had to be found that would accomplish these purposes and still not detract from the pleasant transparency of the room blending into the outside. Here is a very difficult problem, but like most such problems, it has a very simple, but very effective, solution.

SOLUTION: The solution is a fishnet. The use of fishnet drapery proves to be an attractive yet inexpensive answer. Instead of presenting the institutional look and harsh mechanical lines of a wire mesh, they hang as delicate foils in soft folds. Weighted at the bottom they effectively cushion the shock of balls caroming towards the windows and pleasantly define the transition from the interior to the outdoors, only as suggestively as "a sapling stops the eye in nature." To say the least the solution of this problem came about through an imaginative but down-to-earth approach.

Credits: This multi-purpose room is a part of the Bedford Park Community Building, Bedford Park, Illinois. N. R. F. Swanson was President of the Parkboard. The scheme was developed in the offices of Perkins and Will, Architects-Engineers. Photography by Hedrick-Blessing.


SKYLIGHT
LOUVERS



CASE STUDY 34

PROBLEM: How can provisions be made for an interim lunch and activity area for the first unit of an eventually complete elementary school?

APPROACH: Here is a case in Michigan of a challenging situation faced by every state in the country. The situation is this: The community is growing; taxable valuation is low because the district is entirely residential; and current enrollment calls for 10 classrooms immediately with at least six more in a few years. The planners, confronted with this situation requiring an ultimate need of 16 classrooms with all accompanying facilities, did the logical thing and prepared a master development plan, a plan for successive construction stages as finances and needs would permit. This plan called for the first stage of construction to be a classroom wing to take care of the immediate needs of 10 classes. The second stage included another classroom wing for the six additional classrooms. And the third stage included a multi-purpose area which was to be the connecting link between the classroom wings. See sketch (right). But what about lunch and activity facilities for the first wing, since there was only money enough to build just classrooms? Every school architect at one time or another faces this same problem. The architects in this case called on the corridor to help them out.

SOLUTION: The solution reached consisted of a modified single-loaded corridor plan with offices, library, heating plant and toilets arranged along the corridor across from the classroom. The balance of the corridor length was widened to 20 ft. for eating and assembling purposes. Here is another case of a multi-functional corridor. The kitchen was placed at the end, leaving an activity area of 20 ft. by 100 ft. This simple scheme provides a solution economical in every respect. Although the ceiling height is but 8 ft. because of the classroom clerestory, the space has proved to be successful in accommodating the lunch and activity program. The community, too, has made full use of this space. This community might find that what it has now in eating facilities could prove as desirable as the more elaborate arrangement planned for the future.

Credits: This scheme was planned for the Maple Grove School District near Lansing, Michigan, by Warren S. Holmes Company, Architects. The Superintendent of Schools was Harley A. Franks. The first wing of the ultimate school plant was completed in 1949.

CASE STUDY 35

PROBLEM: Can flush ceiling surfaces be achieved without expensive, cumbersome dropped ceilings?

APPROACH: The planners approached the problem with this sort of thinking: Flexibility should be inherent in the design of any school building. New schools should have the flexibility which allows moving interior partitions efficiently and economically. If flexibility is to be obtained at the expense of the present educational program, then such flexibility may be educationally and economically unsound. Therefore every effort should be made to find low cost methods for obtaining the quality of flexibility in new schools. The planners felt that if expensive dropped ceilings could be eliminated and a flush ceiling surface provided, the problem of future movement of partitions would be simplified. Their approach was then made in the direction of achieving this goal—to design school building spaces which could be tailored to the present educational program without so dating the building that it could not be adapted to future educational programs.

SOLUTION: The solution is unique—an "upside down" roof. The architects developed a system of structure which called for the roof to hang from the beams instead of resting upon them. This relatively simple type of construction contributed to maximum flexibility in the future movement of partitions. The problem of flashing and painting the exposed steel beams was solved by the use of an integrally colored, sprayed-on plastic which can withstand expansion and contraction. The sprayed-on plastic eliminates the need for painting and can be added to every 8 to ten years by the same spray method. The planners feel that in this particular case, where the classroom wings are stepped up to take care of contour changes economically, the rhythmic pattern of the exposed beams provides a pleasant interruption of the otherwise unbroken plane of the roof. They concluded that if the roof is to be exposed to view, then it should be made beautiful for the same reason a façade should be made beautiful. So in this case in solving one problem—the problem of flexibility—a problem of aesthetics was also solved. It is surprising how often in solving architectural problems the esthetic functions are automatically taken care of when the problems of physical functions are solved.

Credits: This scheme was developed for a high school at Newton, New Jersey, by Architect Jay C. Van Nuys and his associates. The Superintendent of the School was Stuart R. Race. Walter D. Cocking served as Educational Consultant. Photography by Douglas Meaney.

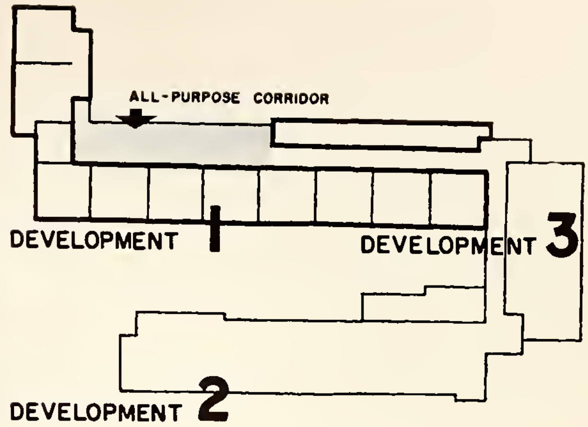
CASE STUDY 36

PROBLEM: Can both auditorium and playroom be provided at reasonable cost?

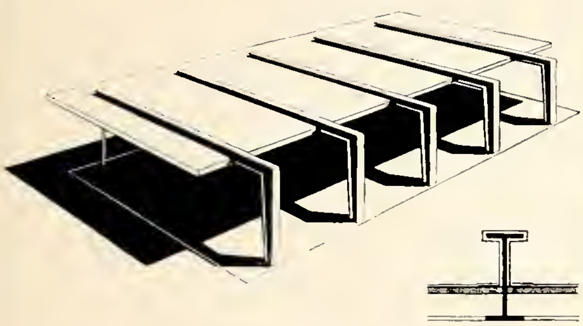
APPROACH: The available budget for new schools often makes necessary the choice between a playroom or an auditorium, and the result is usually that the playroom is built and must double as an auditorium as best it can. However, the savings anticipated as the result of eliminating an entire room of considerable area have not been fully realized, since obviously the solution limits the use of the room and makes it necessary that the room be specially adapted for both purposes. Drapes must be provided for the windows for auditorium use, and storage area must be provided for the folding chairs and perhaps a folding stage. If the stage is built in, additional area must be provided. Though it would not be possible to provide an additional auditorium without adding floor area, savings have become apparent in studies involving related perimeter and foundation costs.

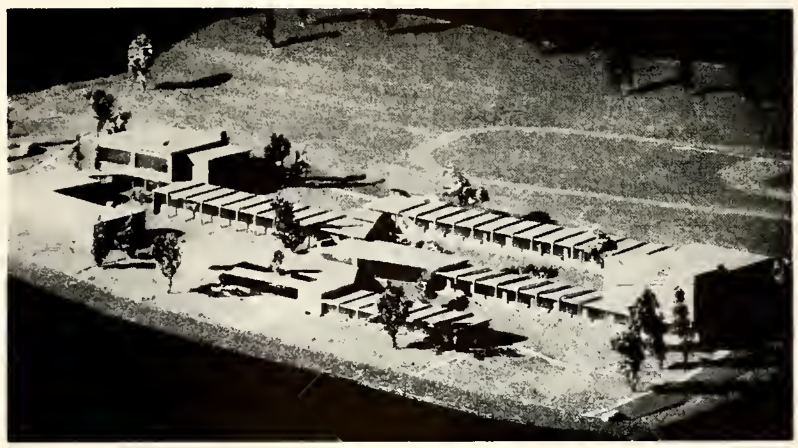
SOLUTION: Even in a single story scheme, the playroom walls must have footings of depth depending upon load and upon soil and frost conditions. This perimeter and depth of wall below the floor slab is necessary yet unusable. By locating an auditorium of reasonable size underneath the playroom this unusable wall became usable as a part of the auditorium walls. An initial part of the construction necessary for an auditorium already existed, so that the final cost was substantially reduced. The rooms were located at offset levels, and the auditorium did not become a basement room, both rooms being a half flight of stairs from the main corridor level and therefore convenient to both school and community use traffic.

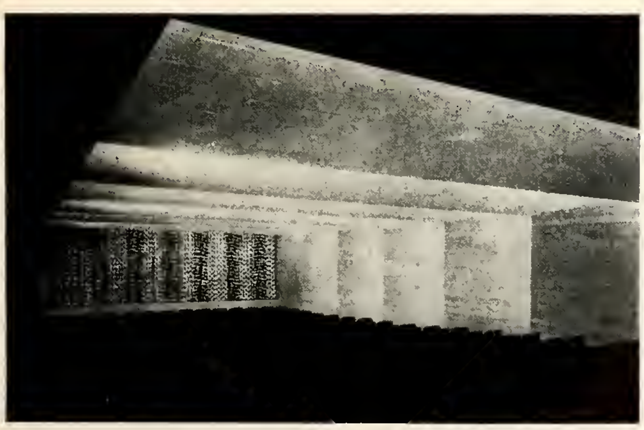
Credits: The auditorium-playroom unit is a part of the Blythe Park School, Riverside, Illinois, designed by Perkins and Will, Architects-Engineers. The Superintendent of Schools was Ludwig J. Hauser. Photography by Hedrick-Blessing.

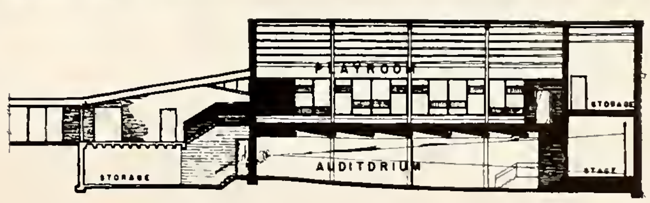


ALL-PURPOSE CORRIDOR
DEVELOPMENT 1
DEVELOPMENT 3
DEVELOPMENT 2









PLAYROOM
STORAGE
AUDITORIUM
STORAGE
STAGE

CASE STUDY 37

PROBLEM: Can bilateral lighting be provided at low cost on a double loaded corridor?

APPROACH: The planners, in the early stages of design, concluded that in this particular case the new school should be planned around a classroom arrangement which (1) has classrooms on both sides of a corridor and which (2) provides for bilateral lighting in each classroom. They made an analysis of the conventional dropped corridor scheme and came up with these questions: Is it necessary to have the heavy construction required by two different longitudinal beams at the lower (corridor) and upper (classrooms) roof? What about snow in the roof valley caused by the dropped corridor? And what about the cost and maintenance of the extensive flashing required by having to drop the central corridor? Could not a scheme be devised to eliminate such flashing and to minimize the heavy construction? In an attempt to answer this last question, the architects decided that perhaps they could find an answer in the development of a "monitor" type bilateral scheme. Many studies were made before such a scheme was developed, but as it turned out the solution was simple and it provided logical answers to the questions mentioned above.

SOLUTION: The final scheme is a "monitor" type bilateral lighting arrangement. A monitor 24 ft. long (classrooms in this case are 32 ft. long) is provided for each classroom. It is of simple construction, fabricated of lightweight channels merely resting on the main roof construction which carries through in the form of a butterfly roof. See sketch above. The monitor extends over three-fourths the distance of the classroom, and with the aid of glass blocks provides ample bilateral illumination throughout the entire corridor side of the room. The architects are convinced that they realized a 10 per cent saving by the use of this scheme over the conventional dropped corridor scheme.

Credits: This cross-section was developed for the Kemper Elementary School, Arlington, Virginia by John Hans Graham and Carl G. Lans, Associated Architects. The Superintendent of Schools was William Early; Assistant Superintendent in charge of construction was Edward J. Braun.

CASE STUDY 38

PROBLEM: Can improvement be made upon the conventional metal lockers for storing clothes in an elementary school?

APPROACH: Is the conventional metal locker the only solution for storing clothes in the elementary school? The architects on this project thought perhaps there was a better solution, and they set out to find it. First they analyzed the problem of storing pupils' clothes. They found: (1) there must be ample space to hang coats; (2) there must be some way to store hats and caps; (3) in this project there must be some place to store lunches; (4) there must be a place to store overshoes; (5) regardless of how the storage units are planned, they must be easily cleaned; (6) such storage space should be well ventilated; (7) and last, but not of least importance, these storage facilities must be economical. After setting up these objectives, the architects then used them as evaluative criteria for judging the conventional metal locker. They found the metal locker to be "expensive, tinny, noisy, hard to clean, without proper ventilation for drying snow covered coats and wet muddy overshoes." The next step was to make studies to see if improvements could be made and all objectives achieved.

SOLUTION: At the right are some original sketches of two schemes which are to be used in a new elementary school. Unit "A", an open type case detailed as part of the mill work contract, seemed to the architects to be a logical answer. The case, which also serves as a partition, rests on a continuous ledge of treated concrete. The ledge, easy to clean, is the place for wet overshoes. There is an open shelf for hats, caps, and lunches. Wraps are hung in groups of four on hangers in open bins which are economical as well as easy to clean. By closing off area above the locker with glass, the unit is essentially a storage wall which separates the corridor and the classroom, thus eliminating partitions. This unit, Unit "A" was designed for the upper grades. Unit "B" was designed for the lower grades and is portable. Note on sketch that a low seat is provided to give stability, as well as seating space for the tots to use in putting on their clothing. A corkboard is mounted on the back. This unit is on rollers and can be easily moved about and used in connection with other portable units to make setups for teaching situations. Unit "B" is also economical and serves as a screen and tackboard as well as a storage unit.

Credits: These units, designed by Smith, Voorhees, Jensen and Associates, were in connection with the Taft Elementary School, Humboldt, Iowa. The Superintendent of Schools was Clyde D. Mease and Dan Cooper was Educational Consultant.

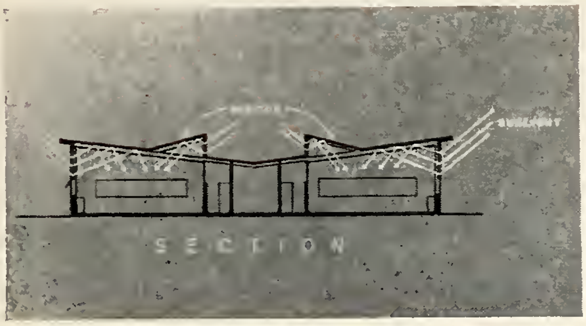
CASE STUDY 39

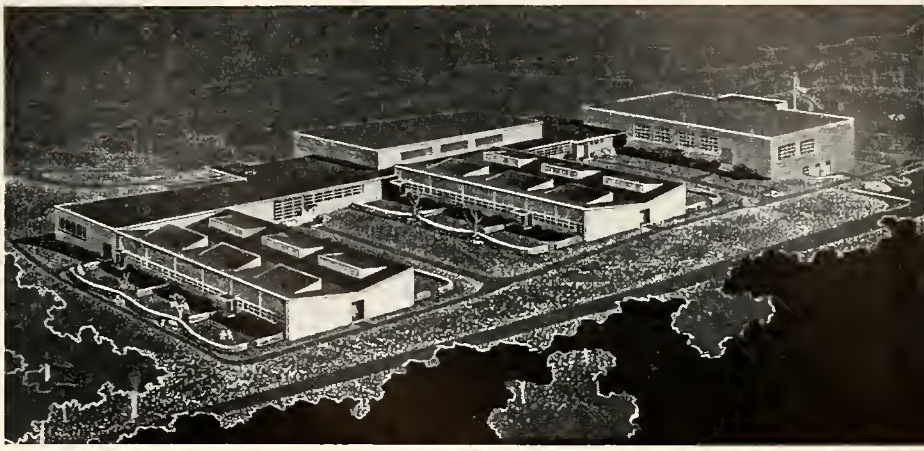
PROBLEM: How effectively can artificial and natural lighting be integrated?

APPROACH: "Integrated design," a household phrase in the offices of these architects, designates the philosophy behind this project. During the very early stages of the planning of this school, the architects and their educational associates set out to achieve the following objectives: (1) to design a "friendly" classroom; and (2) to make every part of the classroom (such as a heating unit or an artificial light source) be an integral part of a highly unified architectural composition. In the development of schemes toward achieving these objectives one of the planners said, "While we are at it, why don't we integrate the natural lighting with the artificial lighting?" The illuminating engineer was immediately called into the planning picture. After a great many conferences by all concerned—architects, engineers, and educators—it was decided to make the ceiling itself a uniform light source and to light the ceiling by both artificial and natural means. It was also agreed by the planners that this lighted ceiling should be brought down to such a distance as to produce "a friendly classroom at child's scale." They agreed that the most desirable ceiling height in this case should be 7 ft., an unprecedented low height.

SOLUTION: The approach led to a very successful solution. Artificial and natural lighting have been integrated very effectively. The natural light enters the room from clerestory windows into a "light plenum," then into the classroom through an egg crate ceiling. Artificial light also originates in the light plenum and bounces down into the classroom through the egg crate ceiling. Sun which enters the clerestory windows is controlled by a 4-ft. solid portion of the ceiling, fondly called by the architects "an inverted sun visor." The light plenum also serves as a pipe chase and space for communication and electrical runs. The low ceiling creates a very pleasant and intimate environment enjoyed by the teachers as well as the students.

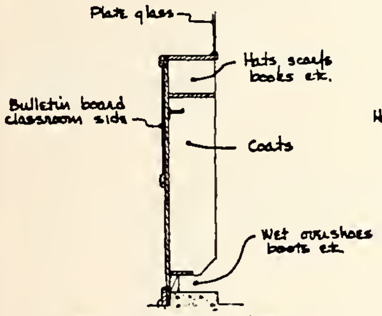
Credits: This elementary school in Albany, Texas, was designed by Caudill, Rowlett, Scott and Associates, Architects-Engineers. J. W. Hall, Jr. served as Consultant on Illumination. George Wilcox was the Educational Consultant, and Roy Hathaway was the Superintendent of Schools during the planning stage. Charles Lindsey, who replaced Hathaway, served as Superintendent during the final development of this school. Photography by Ulric Meisel.



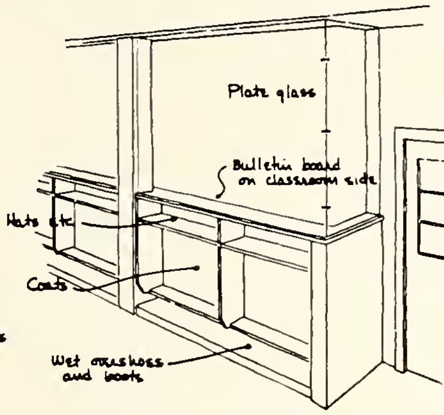


UNIT A

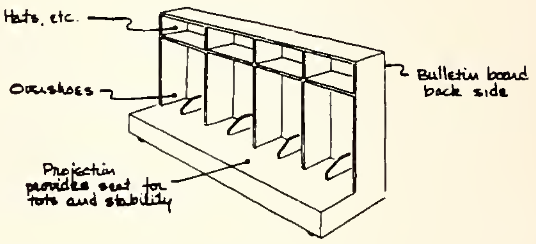
UNIT B



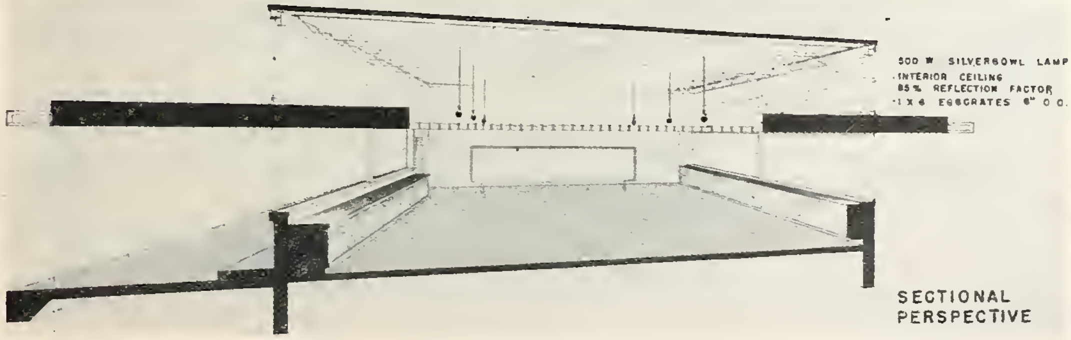
Section corridor wardrobe



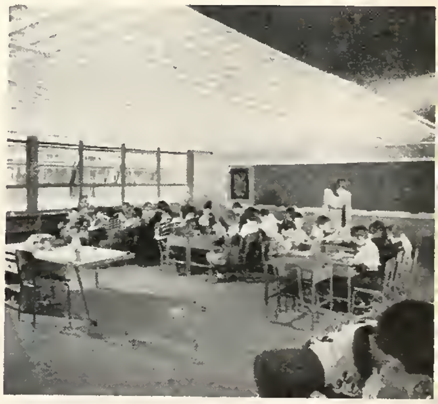
Corridor Wardrobe



Portable wardrobe



SECTIONAL PERSPECTIVE



CASE STUDY 40

PROBLEM: Can bilateral lighting be achieved for multi-story classroom units?

APPROACH: Here is how Ray Ovresat, one of the architectural associates, discusses the problem and points to a solution. "Whether in a single story unit or a multi-story unit, classrooms must still serve the same purpose, offering a comfortable place for study in cheerful surroundings that will encourage enjoyment in learning. Daylight is an all-important ingredient, adding sparkle and bringing alive the warmth in the colors and materials of the room. In a single story unit daylight is easily flooded in from opposite sides of the room, through low windows on the one side and clerestory windows above the corridor roof on the other side. There is no dark area in the 'back' of the room, but instead a pleasant room with a high level of well-balanced light, aided when necessary by artificial illumination. Could a similar satisfactory answer be found for a multi-story scheme?" It was.

SOLUTION: See photograph of model and sketch of perspective cross section through classroom unit. With a single-loaded corridor scheme and the wall between classroom and corridor carried up only to locker height, the exterior corridor wall became in effect a second window wall for the classrooms. Depending on the amount of traffic in the corridor, the space above the lockers could be glassed in or left open. In either event, a truly bilaterally-lighted classroom is the result, with the width of the corridor ceiling acting as a sun shade. The principal windows look north upon a sun-drenched landscape. South light borrowed from the corridor balances the color temperature of the north classroom windows without admitting direct sunlight.

Credits: This scheme was developed for the Keokuk High School, Keokuk, Iowa, by Perkins and Will, Architects-Engineers. The Superintendent of Schools was James C. Wright. Photography by Hedrich-Blessing.

CASE STUDY 41

PROBLEM: Can economy be achieved through changing the geometry of the layout of the classrooms?

APPROACH: The planners of this school made careful analysis of the periphery of the usual classroom layout. They found that considerable saving of perimeter walls could be achieved if the classrooms were so arranged that the small side of the classroom served as the outside wall. They reasoned that outside walls cost much more money than inside walls; therefore, the approach was to design a classroom with minimum outside walls. Another approach was based on the premise that if nonproductive space such as corridors could be so arranged that they would be minimized, savings in construction costs could be made without affecting the educational program. Various schemes were developed, all leading to reduction of corridor space.

SOLUTION: The final scheme as shown in Diagram B resulted in substantial savings. Compare the length of the corridor and building perimeter with Diagram A, which represents the conventional finger plan arrangement. Both A and B have equal enclosed areas. In the case of A, the 36-ft. length is on the exterior wall, except at wing ends and in the case of B the 24-ft. length is on the exterior wall. Note that the geometry of the layouts affects the corridor lengths and the perimeter walls. The savings in the corridors by the use of B amounts to 54 per cent. By using scheme B there is also a saving of 14 per cent in exterior walls. A further analysis showed an over-all construction saving of 8 per cent. Here is a case where economy was achieved without sacrificing education the least bit.

Credits: This school, the Buri-Buri Elementary School of South San Francisco, California, was designed by Bamberger and Reid, Architects-Engineers. James C. Cherry was the District Superintendent.

CASE STUDY 42

PROBLEM: Can improvements be made on combination of cafeteria service with other school functions in an Elementary School?

APPROACH: The planners were of the opinion that the combining of cafeteria facilities with other functions in order to gain maximum use of expensive space is a necessary evil at best, but they believed that perhaps a better combination than Cafeteria-Gymnasium might be possible.

Many difficulties are present in Cafeteria-Gymnasium multiple use, such as:

1. Tables and chairs or benches must be moved back and forth during the day.
2. Gymnasium area is usually much too large for dining purposes and community gatherings such as PTA, teas, etc., after hours.
3. Hardwood floors in gymnasium require greater maintenance when the room is used for dining.
4. Gymnasium is unsanitary for dining because of dust, etc.
5. Gymnasium is not available for that purpose during lunch periods, which approximate 2 to 3 hours at mid-day.

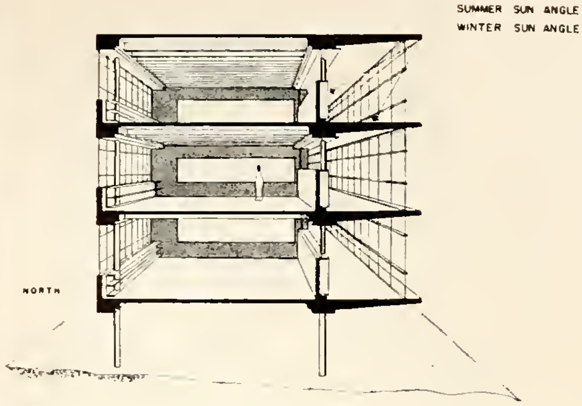
The school administrators were anxious to consider some other approach than the customary solution to this problem.

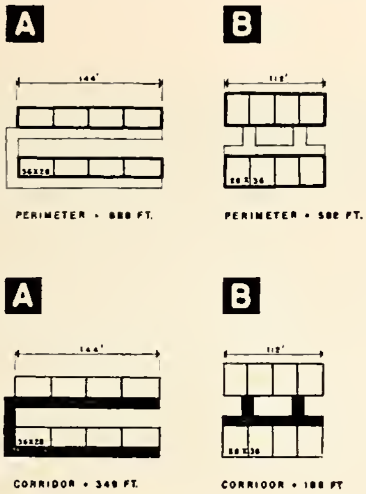
SOLUTION: The architects and the school administrators decided that in this particular school located adjacent to a new housing development, a combination of cafeteria and library offered a logical solution for the following reasons:

1. A relatively small dining room to seat 60 persons at one serving would be satisfactory since the proximity of the school to the patrons allows many children to go home for lunch. Two or three lunch periods per day were planned.
2. Tables and chairs could be designed and set up for dual purpose without moving.
3. The smaller dining room is more in scale with the children and with its function.
4. A greaseproof floor covering could be used and be very satisfactory for both library and cafeteria use.
5. The room is accessible for PTA and other community meetings.
6. With wall space and book room adjacent, the room is satisfactory for a small elementary school library with adequate control by separation of book room for checking out and in.

In order to make the arrangement more flexible still, it was decided to expand the area into the Auditorium-Gymnasium when necessary. This access is provided by a soundproof folding partition.

Credit: Ramona Elementary School for the Ysleta Independent School District of Ysleta, Texas. J. M. Hanks was Superintendent of Schools; Carroll & Daeuble, El Paso, Texas, Architects.


SUMMER SUN ANGLE
WINTER SUN ANGLE
NORTH


A
B
144'
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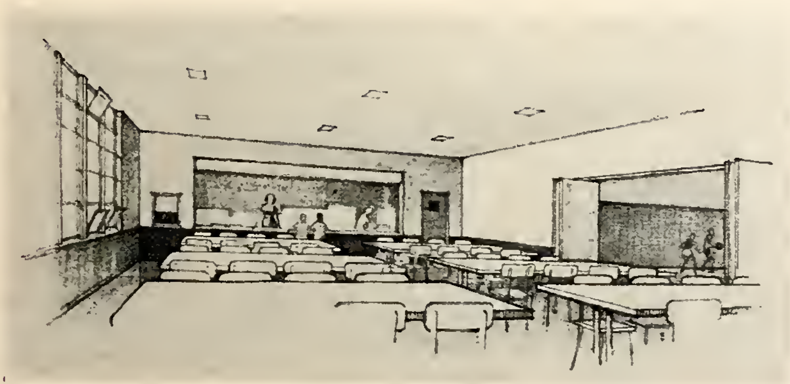
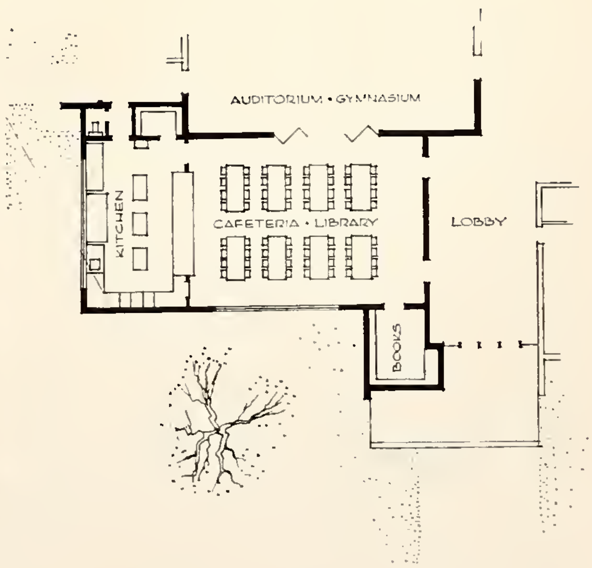
36X28
PERIMETER
A
B
144'
112'
36X28
CORRIDOR
CORRIDOR




AUDITORIUM • GYMNASIUM
KITCHEN
CAFETERIA • LIBRARY
LOBBY
BOOKS

CASE STUDY 43

PROBLEM: Can good natural ventilation be accomplished in both summer and winter?

APPROACH: Good natural ventilation itself is sometimes a difficult thing to accomplish, but when other things are considered, such as light, sound, cold month winds, economy, etc., natural ventilation can be a doubly difficult problem to solve. The planners of this school had to determine the best orientation for the school so as to take full advantage of prevailing breezes and still get proper lighting conditions. A classroom cross-section had to be designed which would:

1. Protect the open corridor (an economy measure) from cold north winds.
2. Protect the occupants of the classroom from the heat and glare of the sun.
3. Allow incoming air to blow across the bodies of the pupils during hot months.
4. Allow incoming air to blow upwards over their heads during cold months.

SOLUTION: The school was finally designed with a 10-ft. overhang on the south side of the building to keep the sun out of the rooms and protect students using the corridor from cold north winds. Glass jalousies were used in the south wall as inlets for the south cool breeze occurring during the hot months. Large projecting windows were used on the north side of the building which provide a maximum outlet during the hot months and yet direct any cold north winter wind that is desired in the room, up towards the ceiling. Tests made by the Texas Engineering Experiment Station proved that this scheme will work. The upper diagram indicates the air pattern for cold month ventilation, and the lower diagram shows the air pattern for hot month ventilation.

Credits: The Crane Junior High School located at Victoria, Texas, designed by Architects Fehr and Granger, Austin, Texas. The Superintendent of Schools is T. A. Rooch.

CASE STUDY 44

PROBLEM: Can outside space be arranged to facilitate classroom activities?

APPROACH: The architects' answer to that question is that outside space not only can but *must* be planned to facilitate classroom activity. The reason is that learning takes place everywhere. Why confine learning within the four walls of a classroom? The space immediately outside of the classroom is there to use; it is high premium teaching space and can be developed at a low cost. But the problem is how to design a classroom unit, made up of both indoor and outdoor area, so that the two form a unified and integrated whole, so that the teacher can easily supervise activity carried on simultaneously in both areas; and so that the indoor area can be effectively screened as to noise, and partially as to vision, without too great a separation between the two. That is a big order, but apparently it has been filled by the cooperation of a creative architect and a progressive educator.

SOLUTION: The inter-flow of interior and exterior space—that phrase can best describe the solution to this problem. See illustrations p. 229. There is no distinct definition between inside and outside. In order that children might work and play in the outdoor portion of this classroom unit during most of the school year, part of the area has been covered to offer protection against the hot sun and rain. Notice the well-organized garden area to be developed as a classroom project. Note too the possibilities of complete supervision by the teacher for both outside and inside classroom activities. Take note also of the paved areas which insure outside work and play space against mud. This fresh solution is a far cry from the general public's conception of a school building—four walls with one punched full of holes for windows. It is living proof that walls are not for keeping the outside out, but for letting the outside in.

Credits: The classroom unit was designed by Architect John Lyon Reid for the John Muir Elementary School, Martinez, California, James C. Cherry was District Superintendent. Photography by Roger Sturtevant.

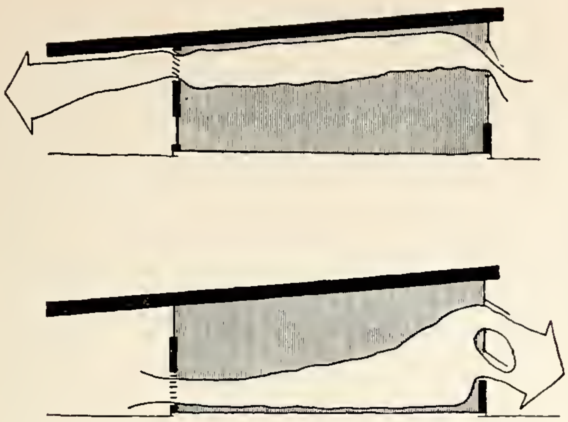
CASE STUDY 45

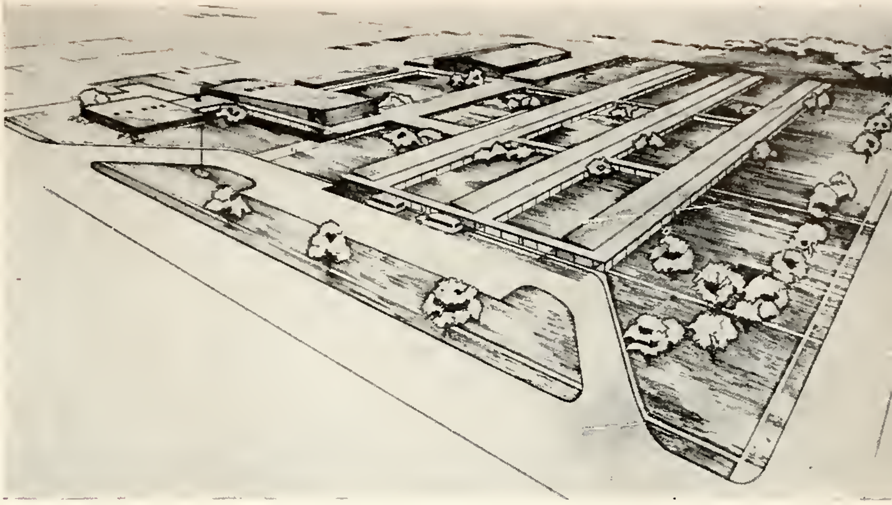
PROBLEM: Is it necessary for classrooms to have ceilings as high as generally required by codes?

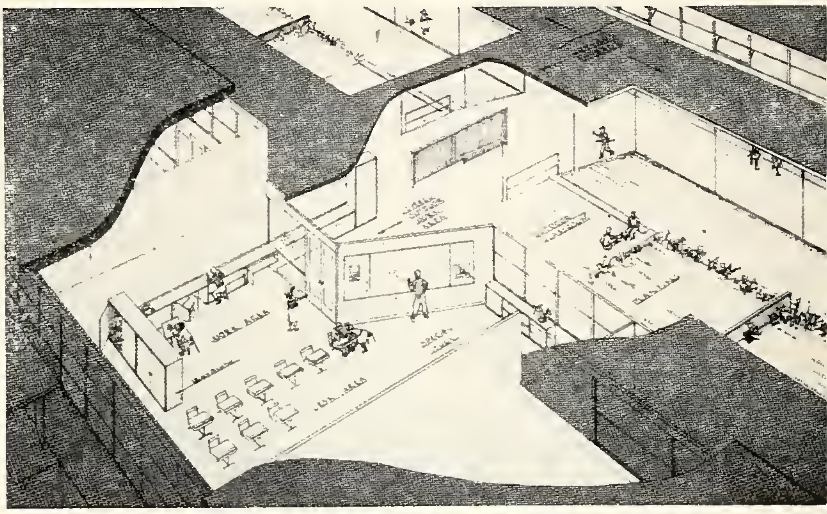
APPROACH: Architects throughout the country have been faced with obsolete codes and standards which have hindered the progress of logical school buildings. The 12-ft. ceiling height standard has particularly held back architects who are trying to lower the cost of school construction by bringing down ceilings to a more desirable height, both from the viewpoint of economical low cubage and from the viewpoint of more intimate surroundings for the school children. In most cases the architects have failed to produce evidence that low ceilings are feasible. But here is a case where the officials were convinced. The architects in this case reasoned: 12-ft. ceilings make good sense in unilateral situations where the depth of the classrooms is no greater than 24 ft., because, to get good lighting where there is only one lighting panel, it is a good rule of thumb to have the height of the ceiling be at least one-half the depth of the room. But where more than one light panel is used, whether it be a skylight, opposing window wall, or clerestory window, the ceiling height could be lowered considerably. But officials whose job is to approve such radical changes must have facts, not architects' opinions. So these architects set out to obtain such facts. They secured the services of the Texas Engineering Experiment Station to test seven different cross-sections, each 10 ft. 9 in. high, a modular size for the type of construction which they proposed. In order to offset the light reduced by lowering the ceiling the architects specified skydomes located near the interior wall. Tests, therefore, were based on variations of a cross-section having skydomes and 10-ft. 9-in. ceilings.

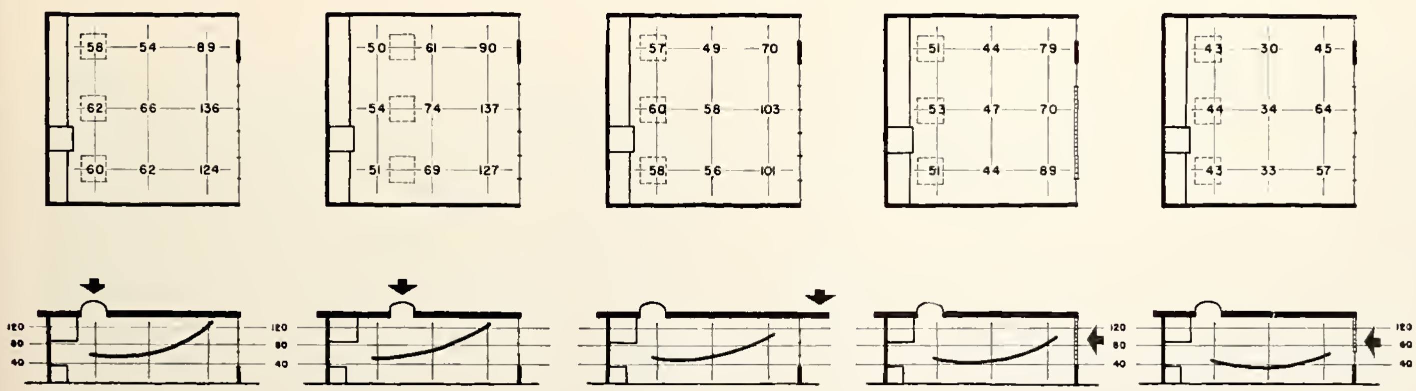
SOLUTION: The results of the testing were gratifying and they gave significant evidences that the 12-ft. ceiling code requirement could be modified. The climax of this project, however, came about when State officials upon reviewing this evidence gave approval to the project on an experimental basis. Five of the test results are shown above. Section "A" consists of 4-ft. square skydomes located 1 ft. from interior wall combined with a window wall. Section "B" is similar with the exception that the skydomes are located 5 feet from the interior wall. Section "C" is the same as "A", the exception being that an overhang has been added (note improvement of distribution without materially hurting the intensities). Section "D" is the same as "A" with the exception of the window wall which has been replaced with glass block wall, having a vertical vision and ventilation strip at one end. And Section "E" makes use of the conventional glass block fenestration plus the skydomes. What do the results prove? They simply prove that a high level of illumination, evenly distributed can be obtained with ceilings as low as 10 ft. 6 in. by a variety of ways, and that the 12-ft. ceiling codes should be limited to unilateral situations.

Credits: These schemes were developed by McLeod and Ferrara, Architects, in connection with planning an elementary school, Arlington, Virginia; Superintendent of Schools T. Edward Rutter; E. J. Braun, Assistant Superintendent.





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43 30 45
44 34 64
43 33 57
120
80
40

A B C D E

CASE STUDY 46

PROBLEM: Can elementary schools be zoned to satisfy functional requirements of both school and community?

APPROACH: Zoning of the main elements of space concerns (1) location of entrances and (2) the functional grouping of spaces. Here is a situation where the site was a handsome park surrounded by a residential development. Children would be coming to the school from all directions, and the consideration of the location of entrances was extremely important. The planners decided that "the new school should have no front or back to the building as such." The grouping of the main elements of space was also considered important. After careful programming, the architects found that the required elements of the building logically fit into three units: a kindergarten unit, an elementary unit, and a playroom-auditorium unit for school and community. All of the necessary elements for a complete school were included in the original program, no future expansion being anticipated, thereby allowing greater freedom in planning. The architects considered zoning important but not important enough to sacrifice a beautiful, pleasant plant; so in the attempt to properly zone the plant they also attempted to establish a residential character in the scale, detailing, and over-all massing of the building that would be in harmony with the neighborhood. Unquestionably, the objectives were achieved. See illustrations at right.

SOLUTION: These objectives are to develop a plan that (1) would adapt itself to requirements of a residential character, (2) lend itself to functional grouping of the elements, (3) have centrally located entrances assuring proper circulation. They are achieved by the use of "rubber joints" (a term coined by the boys in the back end of the drafting room) to connect the three main elements of space. In effect the final scheme is a modified campus plan arrangement in which the three separate masses are joined by two glass corridors. These two connections are shown on the photograph of the model and are designated as "A" and "B". The corridor connection at "A" joins the kindergarten unit (left mass) with the elementary unit (center mass). The "B" connection joins the elementary unit with the playroom-auditorium unit (right mass). The photograph above is of the connecting corridor "B". There are entrances on both sides of the connecting corridors, which satisfy the problem of providing access to the school from all directions of the neighborhood and which provide direct access to any of the three units. Interior doors are provided in the connecting corridors, which actually are vestibules, so that each of the three main elements may be heated, lighted, and maintained separately when necessary. This scheme well satisfies the necessary functional requirement of zoning and does it through a very beautiful and friendly structure.

Credits: This is the Blythe Park School, Riverside, Illinois, designed by Perkins and Will, Architects-Engineers; the Superintendent of Schools was Ludwig J. Hauser. Photography by Hedrich-Blessing.

CASE STUDY 47

PROBLEM: Can a compact plan arrangement be made without sacrificing natural lighting and natural ventilation?

APPROACH: This problem concerned an addition, the limits of which had to be confined to an area bounded on one side by a cafeteria and the other side by the filter bed of a septic tank. In addition to these limits in two directions there was the added space limitation resulting from a small site with little playground area. The planners therefore concluded that any logical scheme of classroom arrangement must have the characteristic of extreme compactness. But they were confronted with the question: Can a compact school have adequate natural lighting and natural ventilation? Certainly the traditional double-loaded corridor school with its unilaterally lighted and ventilated classrooms was no answer to their problem. Poor lighting was inevitable. But the double-loaded corridor, itself, had great merits because of its compactness. So the problem evolved itself in determining how to light and ventilate a double-loaded corridor scheme.

SOLUTION: The solution proved to be simple and logical. In essence it is a highly compact double-loaded corridor arrangement with the long end of the classroom turned perpendicular to the corridor and with clerestory lighting and ventilation. The architects explained their solution briefly with this statement: "We had to keep the building as short as possible, for we only had approximately 275 feet from cafeteria to filter bed. Since it was necessary to have the short dimension of the classroom perpendicular to the corridor to form the building mass within that distance, we had to use clerestory windows for lighting and ventilation. Breeze windows in the corridor wall give us very good cross ventilation which in this climate is essential. Having a restricted budget forced us to keep everything as simple and straightforward as possible. The plan seemed the best solution to our problem."

Credits: The Garner Elementary School, Garner, N. Carolina, was designed by Cooper and Haskins, Architects. The Superintendent of Schools was Randolph Benton.

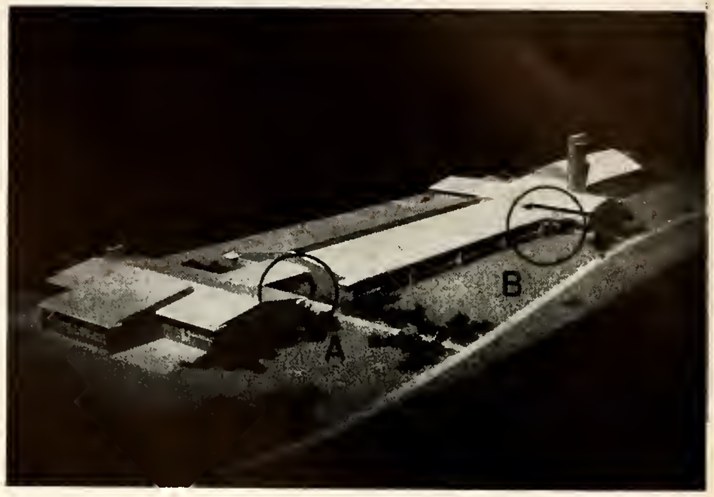
CASE STUDY 48

PROBLEM: How can controlled lighting be achieved on east and west fenestration?

APPROACH: The commanding situation on a sloping hillside overlooking San Francisco Bay favored a multi-story building with a north-south axis, which necessitated east and west classrooms. The planners were confronted with the problem of sun-controlled, high level, evenly-distributed natural light for unilateral classrooms. The Architect had conducted a preliminary experiment, the Cragmont Test, with directional glass blocks in a small Berkeley schoolhouse, and the results recommended this particular type of installation for this building group since the conditions were similar. Therefore, the approach to this problem was made through research.

SOLUTION: As applied to the Portola Junior High School the glass block extends from 6 ft. above the floor to the ceiling, while the continuous clear visual strip below is protected by a 4-ft. cantilevered sunshield on the outside. This construction renders unnecessary the use of manually controlled blinds or shades. This scientific approach to daylight control is intended to effect even distribution of light, bringing it in above the level of the eye and directing it to the inner side of the room.

Credits: This scheme was developed for the Portola Junior High School in El Cerrito, California by Architect John Carl Warnecke. The Superintendent of Schools was Dr. George D. Miner; photography by Julius Shulman.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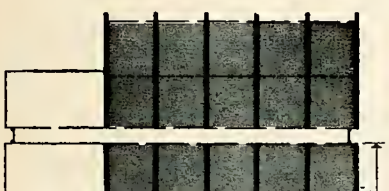
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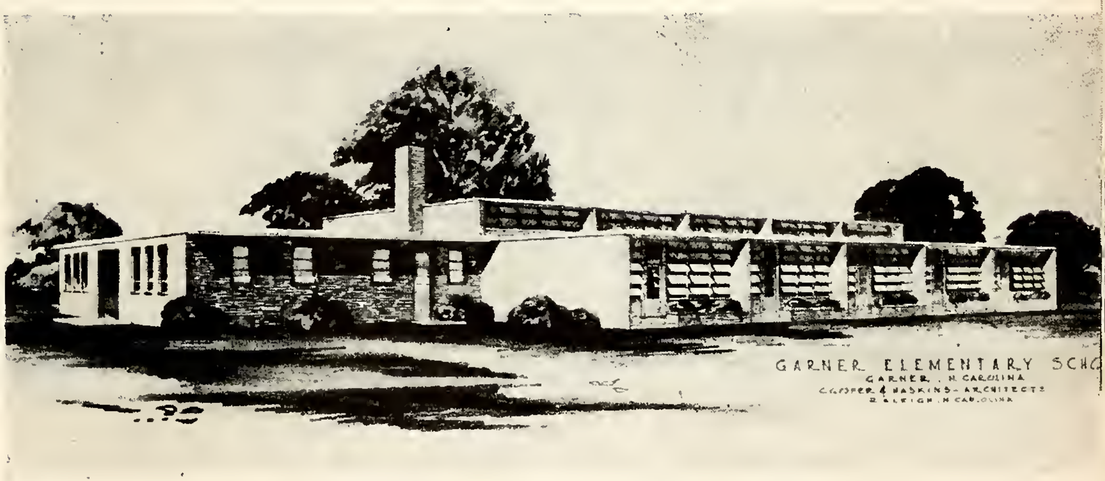

GARNER ELEMENTARY SCHO
GARNER, N CAROLINA

CASE STUDY 49

PROBLEM: Can an Elementary School be built on a precipitous site?

APPROACH: Obviously "Yes," but with what degree of compromising normal educational standards? Consideration of such a site was strongly based on two requirements:

a) To retain a central administration of students arriving and departing by District operated busses.

b) To incorporate a hot lunch program in the new building for serving occupants of the existing building as well as the new.

In studying the problem the planners of this school came early to the decision that here lay mainly a problem of siting. The site was not only steeply sloping, but was strictly limiting in its physical boundaries. Lateral limitations of the site encouraged investigation of a split level scheme. A study of vertical contours revealed minimum grade changes of 6 to 11 ft. within the proposed building line.

Geographical factors indicated natural lighting would be best obtained from bilateral sources east and west. Ease of access to adjacent segregated play areas, as well as egress in time of emergency, were strongly emphasized.

In summary, the approach was based upon the presumption that to work within a stringently limiting budget the requirements must take advantage of site conditions normally considered a liability.

SOLUTION: The Central Service System, composed of multi-purpose room, kitchen and prime adult entrances, was placed on an intermediate bench land. From this elevation, stairs, a half-flight up and a half-flight down, reach toward three classrooms, each on its own bench. A sort of over and under scheme of staggered open corridors backs up the classrooms which face out upon the play areas. Clerestory lighting above each corridor supplements the primary lighting source. The photograph on the left shows the existing site conditions and the photograph on the right shows the proposed solution superimposed over the original photograph.

Credits: This site proposal for an elementary school was developed by McClure, Adkison, and Wilson, Architects-Engineers for Republic School District 309, Washington. The Superintendent as John LaCoste.

CASE STUDY 50

PROBLEM: Can classroom storage be housed to advantage in movable cabinets?

APPROACH: The architect spent several weeks observing storage needs; he investigated good and inadequate storage and studied how the same functions could be housed more adequately. The teachers in work groups evaluated the architect's observations and listed specific materials and objects to be housed and also determined the type of work space, cabinet top and utilities desired in the classroom. Perspective sketches of units designed to house the needs of the classroom teachers were then prepared by the architect and in turn evaluated by the faculty committee.

SOLUTION: Modular units 2 ft. x 2 ft. x 4 ft. were designed with various types of storage: drawers, shelves and cubicles to house the various needs and to provide the desired counter top and work area. To these units were added special cabinets to serve such special needs as teacher's wardrobe, playground equipment, movable chalk board, clay table and wood working. All the cabinets are readily movable by means of glides or casters. Many room arrangements have resulted and the units are readily added to or subtracted from as the use of the room changed. Economy and speed in construction resulted from this solution of classroom storage. Some of the units are shown above and are listed as follows:

A. Benches that can be stacked horizontally and used for shelves
B. Work tables
C. Book storage
D. Drawer unit
E. Library unit

Credits: These movable storage units were designed by Architects Branch and Branch and were first used in the Manette School, Bremerton, Washington. The Superintendent of Schools was Armin G. Jahr.

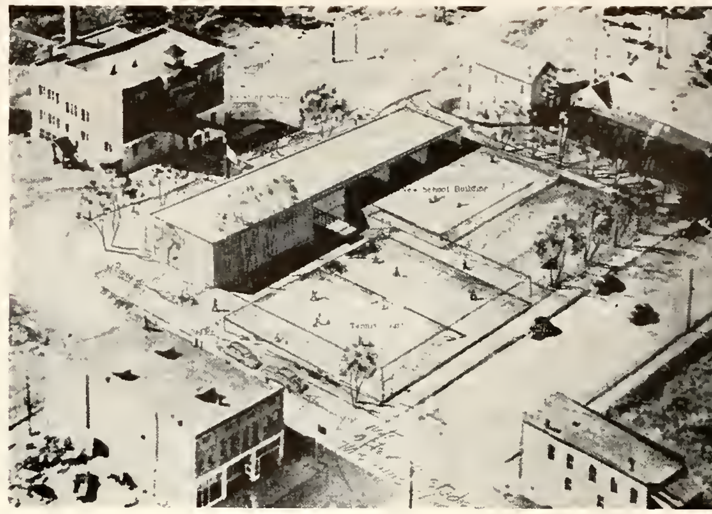
CASE STUDY 51

PROBLEM: Is a semi-outdoor school feasible?

APPROACH: The answer to that question largely is determined by the climate, but in this case it came about through the creativeness of a great architect, Richard Neutra, of course with some help from the climate. One of the most important ideas in his approach to solving an extreme construction cost limitation problem was his belief that from a combination of indoor-outdoor instructional area there will come real economies without hindering the educational program. A careful study of the climatic conditions for the region proved that the semi-outdoor school was feasible.

SOLUTION: Particular climatic conditions and economy of structure were the two principal considerations influencing the design. As the sketch (right) shows, the architectural treatment is in complete harmony with luscious greenery of the tropical climate. The classrooms open with their fold-up walls onto classroom patios, and allow instructional activities to extend easily into the outdoors. The for economy's sake comparatively small classrooms profit from a combination of indoor-outdoor instructional area. The fold-up walls not only permit free communication of the indoors and outdoors, but also provide precious shade so necessary in this Puerto Rican region. The fold-up walls also allow the desired air flow to help dry up moisture and perspiration.

Credits: This scheme was developed by Architect Richard Neutra and his Associated Architects and Engineers connected with planning Urban Schools for Puerto Rico. His thought in this layout has been substantiated in various subsequent projects in tropical Guam.

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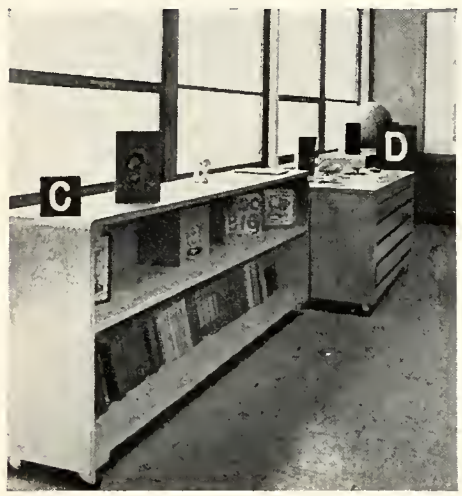
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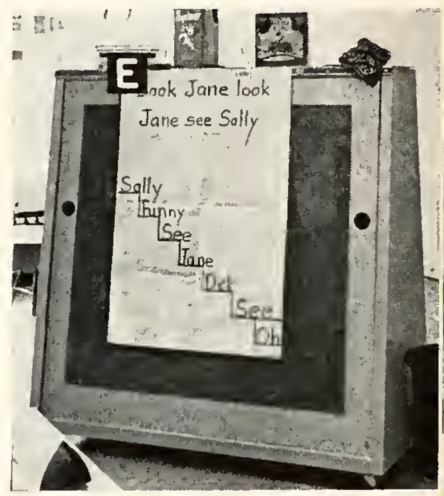
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Jane see Sally
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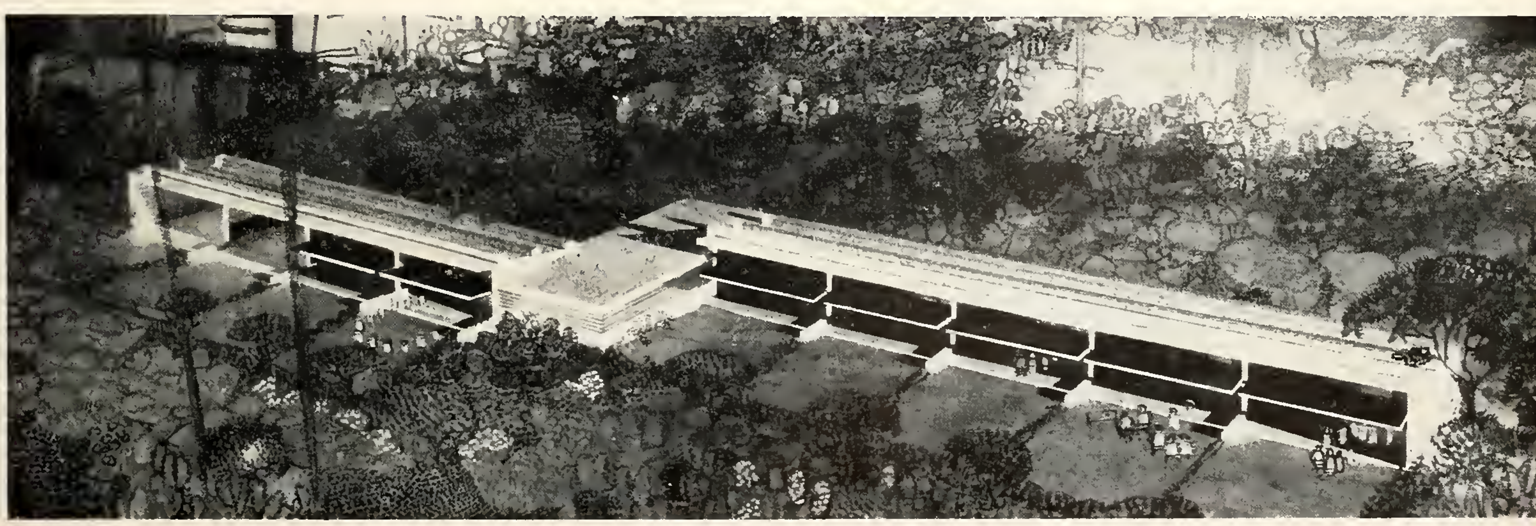
Oh



CASE STUDY 52

PROBLEM: Can a large school be planned with an intimate, friendly character?

APPROACH: This problem was faced by one of the nation's most creative architects. He felt that he could not find the answer in the regimented fingers of the so-called finger plan or in the institutional layout of the customary double-loaded corridor plan. Yet, he wanted the circulation efficiency afforded by the latter and the lighting possibilities of the finger plan. His imagination led him to find the solution in what is now called the "spoke plan." The architect realized that double wings, like double-loaded corridors, halved the number of classroom elements and reduced the number of plan components and the total travel distance at the same time. Owing to a scheme of top-lighting, orientation for that purpose was unnecessary, and the doubled classroom elements could be spread in a series of spokes around a central hub for common activities. When the doubled elements were assigned to age groups, a natural outcome was the provision of courts with wings facing each other for a common unity or a neighborhood, sufficient each to itself. The full height glass walls on the courts make this relationship effective.

SOLUTION: The plan as shown here shows the classroom wings radiating like spokes from a hub of common facilities for all classrooms. Here are some of the features of this plan: 1. From the doors of the farthest of the 26 classrooms to the hub is only 90 ft. of walking distance. 2. Each age group has its classrooms open out naturally into separate play fields. 3. Face to face orientation of room augments unity of age group and forms neighborhoods so that in a school of 26 classrooms no one ever sees more than eight classrooms at one time. 4. There is the flexibility of additions to each age group neighborhood in increments of two classrooms which make allowance for a surge in enrollment through all six grades.

Credits: This scheme was developed for the West Columbia Elementary School, West Columbia, Texas by Donald Barthelme and Associates, Architects. The Superintendent of Schools was J. C. Rogers, Jr. Photography by Ulric Meisel.

CASE STUDY 53

PROBLEM: Can classrooms be designed for dining purposes?

APPROACH: This problem came up in the planning of a classroom addition to an existing elementary school. It became apparent that the small lunchroom and kitchen would have to be expanded or the gym would have to double as a cafeteria. Rather than curtail the physical education program the planners decided that it would be more desirable to serve the children in their own classrooms. They reasoned that eating was a social function and a definite part of the educating process. The problem of food transportation was discussed. It was pointed out that dining in classrooms could be as feasible as the current practice of dining in airliners. The approach for finding a solution, then, was made in this direction.

SOLUTION: The classrooms were designed with each having a wash sink and drinking fountain, and flat top desks and individual chairs. The problem of food transportation was solved by a food cart, which is essentially a portable serving table. A second cart was provided for the distribution of trays, dishes, and silverware; it also included the milk containers and the garbage can. When the class is ready for lunch the carts are moved to the classroom door and the food is dished out by two of the kitchen staff. What has this solution gained? For one thing it saves the expense of a large cafeteria. For another, it provides opportunities for children to eat in small groups in quiet, restful atmosphere. A third gain is the social experience shared by all students. And a fourth is the opportunity afforded each teacher to teach his children sanitation, nutrition, and etiquette.

Credits: This problem was solved through the efforts of Branch and Branch, Architects and was first used in the Viewridge School, Bremerton, Washington. The Superintendent of Schools was Armin G. Jahr. Harold Paschal was the Principal.

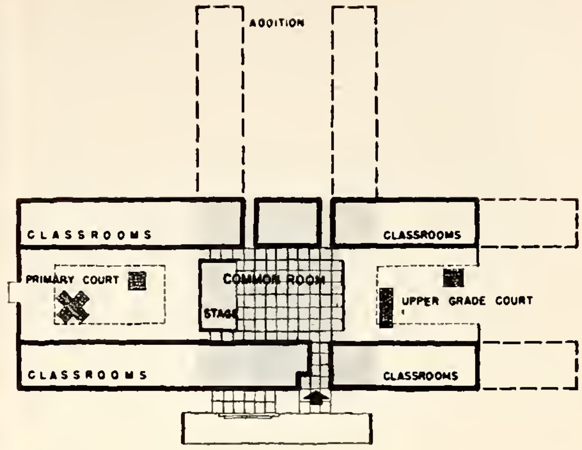
CASE STUDY 54

PROBLEM: What facilities are necessary for outdoor teaching?

APPROACH: The mild, dry climate of the El Paso region of West Texas affords opportunity for outdoor teaching. The educators connected with this project realized this and set out to take advantage of all of the good things nature had to offer. Accordingly they instructed their architects to design outdoor teaching space as an integral part of the classroom unit. Limited site conditions dictated an east exposure for each classroom. Not only were the architects confronted with the problem of outdoor teaching facilities, but they also were faced with the problem of sun control of an east fenestration. After a very careful study of these two problems, they reasoned that if a large umbrella type structure could be devised to keep the sun off the east windows, it could also be used as a protecting device for outdoor classes. The approach, therefore, was to use a sheltered space required for natural lighting control to serve also as an outdoor teaching area.

SOLUTION: The final scheme developed includes a 15-ft. overhang which adjoins each primary grade. It serves to cover the outdoor classroom as well as to keep the sun off the windows. In addition to the roof there are provided brick walls 19-ft. long which serve as separators between the outdoor classrooms. These walls serve not only as screens for privacy, but also as sky brightness controls and sound barriers. Low sills give the teachers adequate supervision possibilities when class activities are going on both in the indoor classroom and the outdoor classroom. Teaching devices such as chalkboards are provided in the outside area as well as in the interior space. Both exterior and interior space are combined to make a unified teaching space.

Credits: This classroom unit was designed by Carroll and Daeuble, Architects for the Ramona Elementary School of Ysleta, Texas. J. M. Hanks was the Superintendent.


ADDITION
CLASSROOMS
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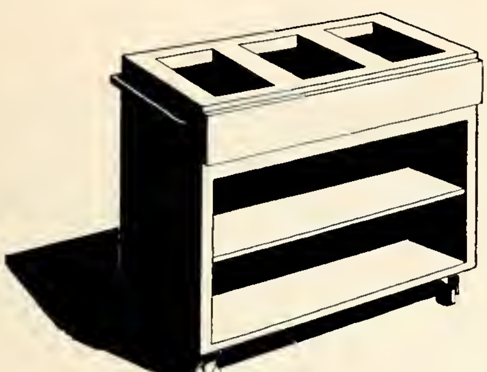
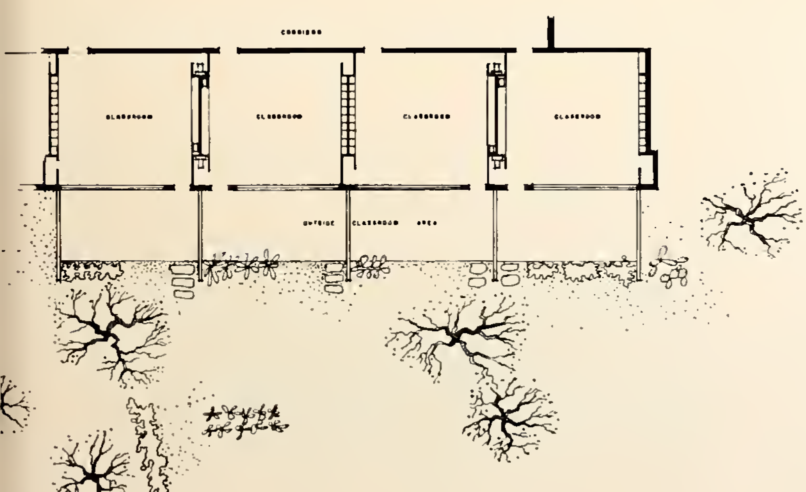
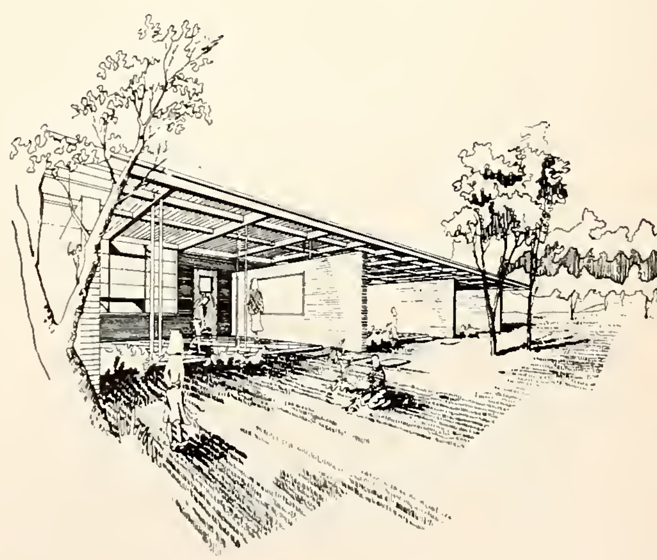
COMMON ROOM
STAGE
UPPER GRADE COURT
CLASSROOMS
CLASSROOMS



FOOD CART





CASE STUDY 55

PROBLEM: How effectively can the site be used to enhance the beauty of the architecture?

APPROACH: This California school derives its design from a necessary consideration of two guiding factors: purpose and setting. Its purpose as a school for beginners through the sixth grade and its splendid hillside dictated its design from general plan to specific detail. In this setting there was a combination of advantages and disadvantages to be brought into equilibrium before satisfactory fulfillment of purpose could be realized.

Lying on the westerly slope of the Oakland-Berkeley hills with a fine view across San Francisco Bay, the 23-acre hill site faced right into the southwest wind, with wind-driven rain and fog sometimes offsetting the advantages of a normally sunny exposure. The building, it seemed, should hug the ground for protection and warmth without departing from the desired type of open plan or disregarding the view. The general philosophy behind the design was therefore to create a functional single-story open plan whose lines and materials and tones would tie the structure into the setting, giving it an appearance of growing out of and being moulded from the hill.

SOLUTION: The wings were so designed that materials of walls and roof blend closely with their natural surroundings. Walls of light-weight, buff concrete blocks blend into the earth tones; roofs of heavy natural redwood shakes, with large overhang and eaves, suggest spaciousness, naturalness and warmth. By scooping out a series of shelves, it was possible to rank up a succession of classroom rows against the hill, each with wide windows for natural lighting on the southwest or bay side, while the main buildings with offices, auditorium and community room remain at the bottom to give the plan its roots. A row of kindergarten and primary rooms sprouts off on this flat lower level too. On the hillside it was possible to manipulate the cut and fill so that the intermediate slopes paralleled the desired roof pitch and for roof planes to be effortlessly continued from building to building to [illegible]ed stairs and passages between. By extending the two upp[illegible] length, eight additional rooms can be provided, and a cafeteria building is also projected in the complete plans.

Credits: Mira Vista Elementary School, El Cerrito, California, Richmond School District, Dr. George D. Miner, Superintendent. Architect, John Carl Warnecke, A.I.A., San Francisco and Oakland. Photography by Rondal Partridge.

CASE STUDY 56

PROBLEM: Can a highly compact school plant have decentralized classrooms?

APPROACH: The approach to the design of the Ring Plan School, a project of Richard Neutra, was made through attempting to achieve a highly concentrated, short corridor, classroom arrangement having individual classroom facilities for open air classes. Only 2½ acres were available for a site. The architect was aware that the conventional double-loaded corridor school possessed the compact character which might help solve his problem, but he also knew that the conventional school presented a great barrier between the indoors and outdoors, making the efficient use of open air classes impossible. His approach, therefore, was made independent of existing schoolhouses.

SOLUTION: Such an approach could only result in a fresh solution. Arranged in two semi-circles, for shortening horizontal distances, the one-story classroom wings (2) surround an interior play-court with a pool in front of the gymnasium (1) and on the outside open into individual classroom patios separated by radial hedges (not shown). Patios and classrooms connect through upfolding glass doors. The entrance building contains the administration suite, library, lunchroom and solarium on a multi-story arrangement. The gymnasium building (1) also is a multi-story arrangement with provision for assemblies and shop activities. Classrooms contain decentralized portions of the collections of instructive material and the library. Adjoining compartments hold decentralized washrooms and toilets for both sexes.

This school, designed in the twenties, is a forerunner of top-lighted schools which provide for desired freedom from regimentated seating.

Credits: This is the Ring Plan School, a project of Architect Richard Neutra. Although it was never built, its influence has been felt throughout the nation. It was designed in 1926.

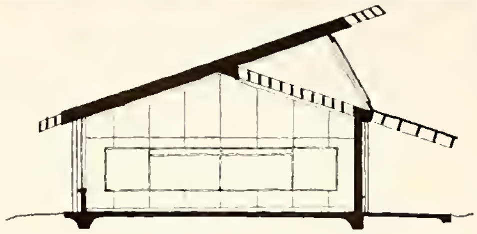
CASE STUDY 57

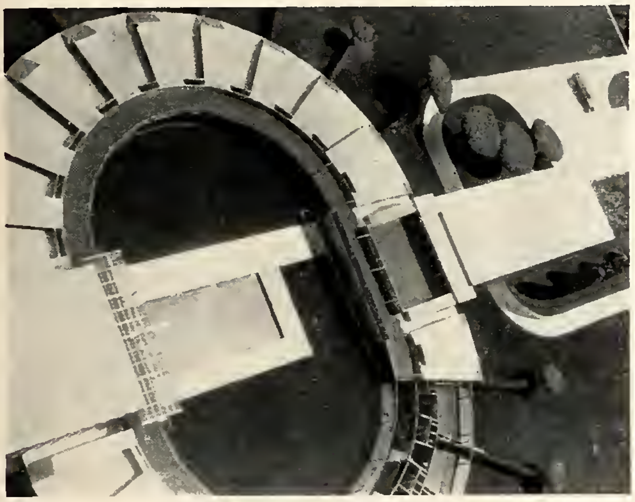
PROBLEM: Can the space of the corridor in elementary schools be captured for use in classroom?

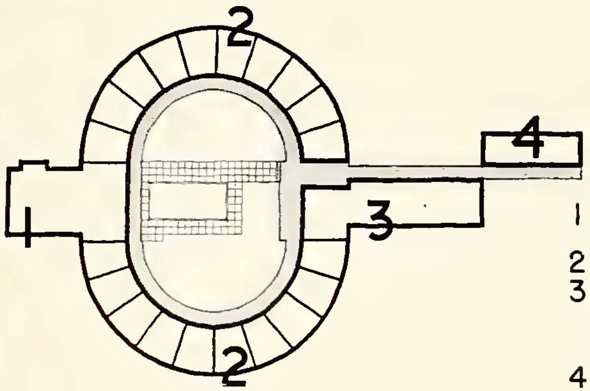
APPROACH: The planners of this school felt that corridors should serve as more than just places to walk. After an examination of the educational program they found that very little use was made of the corridors during school hours. The program was based on the self-contained classroom concept. As in so many building situations, there was a limited construction budget, making a situation where every square foot should be used for educational purpose. The planners asked: Are corridors feasible under such circumstances? Why not make walking space into teaching space? Why can't the "open plan" used in residential architecture be used in schools? This kind of fresh thinking led to the scheme illustrated above.

SOLUTION: The solution is an arrangement of classrooms grouped so that circulation goes through each classroom rather than around it. Movable wardrobes serve as space dividers. These units are located near the south fenestration and offer protection from the direct rays of the sun. By the elimination of the customary corridor, bilateral lighting is achieved without expensive roof breaks. This is one of the first attempts at using the so called open plan in school planning.

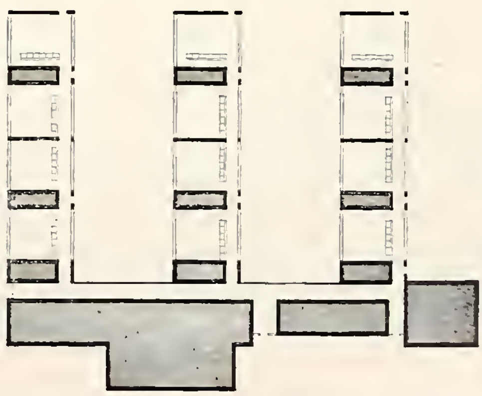
Credits: This is the Elementary School in Plymouth, Michigan, designed by Eberle M. Smith Associates, Inc. Architects. The Superintendent o Schools was Russell L. Isbister.







1 AUDITORIUM
SHOPS
2 CLASSROOMS
3 SOLARIUM
LUNCHROOM
LIBRARY
ADMINISTRATION
4 GARAGE



CASE STUDY 58

PROBLEM: Can corridors be used for teaching purposes?

APPROACH: The development of this scheme is a prime example of how fresh solutions can be achieved through close cooperation of the architect and the superintendent. In the early stages of planning, these two key planners laid down this premise: "Every square foot of enclosed space should be used for educational purpose." The two had teamed up previously on another school design which included a corridor used for assembly, play, and dining; so the multi-function idea was not new to them. After a great deal of study of all the problems relating to this particular school plant, it was decided that the grouping of classrooms should facilitate bilateral lighting and ventilation and that the circulation should be through the work area of the classroom unit. In other words, the decision was to take the space which is customarily used as perimeter corridors and put it to work for education by making such space into a work area. The planners reasoned that if there is heavy traffic of pupils between classrooms at least there would be minimum disturbances since the flow will be in the work room area. The approach lead to a plan which resembles the "open plan" found in some of the classic modern houses where halls have been eliminated for more usable space.

SOLUTION: The sketch (right) of the plans shows the layout of this elementary school. On the left is a grouping of six classroom units, and on the right is an auditorium which is separated from the classroom wing by an open playshed. The classrooms are self-contained units with each having direct access to both boys' and girls' toilets. Adjoining the classroom is a work area which also serves as circulation space during inclement weather. However, there is outside circulation space to the office and auditorium to be used most of the time. The work area is separated from the classroom area by only a free standing translucent glass screen which also serves as an eye-protecting sky screen. Wrap storage, work cabinets and sinks also are parts of the work area. The superintendent of schools reports that there is no problem of disturbance when teachers and pupils pass through the work area.

Credits: This is the Southwest Elementary School, Clinton, Oklahoma. The Superintendent of Schools was Al Harris. Caudill, Rowlett, Scott and Associates were the architects.

CASE STUDY 59

PROBLEM: How effectively can a large auditorium, a little theatre, and an arts and crafts unit be combined?

APPROACH: It was decided by the educational consultants at the outset that it was not necessary to build an auditorium to seat the entire student body at one time, and that the educational program could be just as effectively accomplished by an auditorium seating half of the students. Large performances could be repeated, and when one full assembly was required it could be held in the gymnasium.

Since it is becoming increasingly difficult for many high schools to obtain auditorium and little-theatre facilities due to rising costs, the architect endeavored to obtain maximum efficiency and minimum costs in order to make these facilities possible by utilization of multi-function spaces and creating the most integral operation.

SOLUTION: A fan-shaped unit in which all three functions are integrated, both from the point of view of student-use and the public, was designed. A corridor, forming a segment of a circle, curves around the little-theatre and connects all spaces with the main lobby adjoining the large auditorium. This corridor breaks off into a covered walk at the opposite end, connecting the group with the adjoining school buildings. For flexibility, economy, and efficiency in operation, the stage of the auditorium and the stage of the little-theatre are adjoining and connected by a wide door permitting movement of scenery and equipment. The same workshop and dressing rooms serve both facilities, the dressing rooms being downstairs to each stage. The arts and crafts rooms are off to one side of the little-theatre and are accessible to the little-theatre and the auditorium.

The high school will accommodate 1725 students.

Credits: Capuchino High School, San Bruno, California; San Mateo Union High School District, Thomas F. Reynolds, Superintendent. Architect, John Carl Warnecke, A. I. A., San Francisco and Oakland. Photograph by Moulin Studio.

CASE STUDY 60

PROBLEM: Can successful architectural arrangements be made for combining the gymnasium, the auditorium, and the cafeteria in elementary schools?

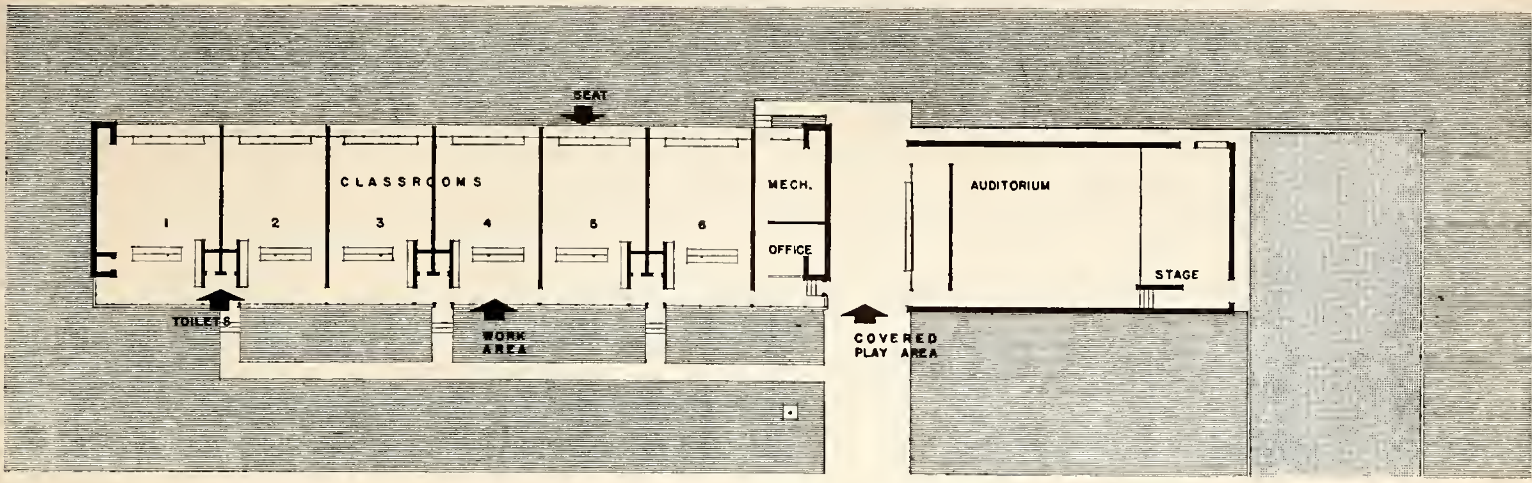
APPROACH: Despite the experts' advice against this combination, successful arrangements must be found; otherwise, due to inadequate funds, many schools will be forced to abandon one or two of these functions in favor of the third. The greatest problem therefore was to determine the arrangements which best alleviate the physical difficulties inherent in such a combination. Study of the problem and research showed the following usual shortcomings: natural lighting often is located incorrectly; the stage and wings are too small; the backboards interfere; floor materials are not suitable for dual use; projection booth is either omitted or is taken from space usable for other purposes; inwall tables not properly located; acoustical treatment not adequate; stage access to corridor often not included.

SOLUTION: The stage is located parallel to the long dimension of the court, thus providing a wide proscenium and better than average wing space; the backboard problem is eliminated; additional side seating space for basketball games is available on the stage. Natural lighting is received through wall-to-wall windows placed opposite the stage; players shoot toward baskets without background glare, and audience does not have bright windows in its field of vision. The principal seating space for sport fans is located on side line opposite stage. Inwall tables are placed in adjacent wall. Minimum width of this space is equal to extended inwall tables plus 2 ft.

Court floor is hardwood to point 1 ft. outside of court lines, and balance of the room is asphalt tile. Thus, spectators' space and eating space is over asphalt tile floor which may be scrubbed. Ceiling is acoustical plaster.

The projection booth is suspended from ceiling, accessible by fixed ladder and equipped with storage space for projection equipment. It doubles as space for scorekeeper and officating of some sports. (See cut). One stage wing connects directly to corridor.

Credits: This solution is offered by Lawrence and Dykes, Architects. It is the Frazer Public School, near Canton, Ohio. The County Superintendent was Thomas C. Knapp.


SEAT
CLASSROOMS
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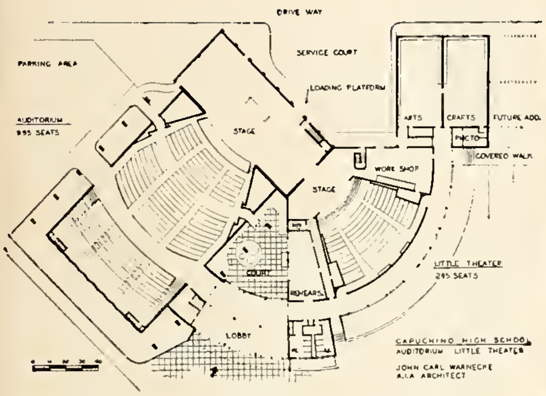
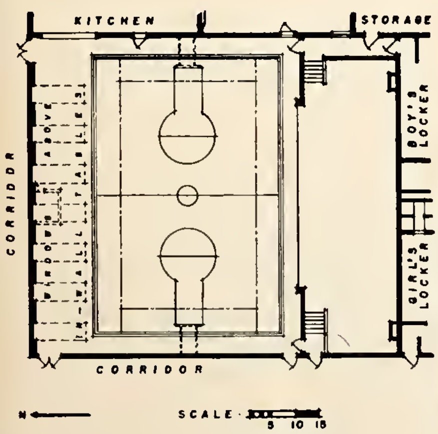
MECH.
OFFICE
AUDITORIUM
STAGE
TOILETS
WORK AREA
COVERED PLAY AREA


DRIVE WAY
SERVICE COURT
PARKING AREA
LOADING PLATFORM
AUDITORIUM
995 SEATS
STAGE
ARTS
CRAFTS
FUTURE ADD.
PHOTO
COVERED WALK
WORK SHOP
STAGE
COURT
REHEARS.
LITTLE THEATER
295 SEATS
LOBBY
CAPUCHINO HIGH SCHOOL
AUDITORIUM LITTLE THEATER
JOHN CARL WARNECKE
A.I.A ARCHITECT


KITCHEN
STORAGE
CORRIDOR
BOY'S LOCKER
GIRL'S LOCKER
CORRIDOR
N
SCALE
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CASE STUDY 61

PROBLEM: How can a school plant be designed for three-phase development?

APPROACH: The architects were faced with the problem of building to meet current needs, and at the same time of planning for future needs which could not be predicted because of the fluctuating growth of population in Southern California, particularly in the area where there are a number of migratory workers. Accordingly, it was seen that a three-phase building program must be developed to take care of this unsteady situation.

A schedule was set up to complete the entire building program in five years.

Realizing that you should build now for today's needs, but plan now for tomorrow's needs, the architects arrived at a unified plan whereby what is built now will fit harmoniously into a well-considered, ultimate school plant.

SOLUTION: The buildings shown in black on the layout plan constitute the first phase, buildings shown in gray the second phase, and buildings in white the third phase. The plan introduces a semi-departmentalized program for grades seven and eight, and separates that group from the lower grades housed north of Elizabeth Street. The cafeteria-assembly building is placed centrally for joint use of both groups.

Credits: This is the LaVerne Primary School, LaVerne, California, planned by Kistner, Curtis and Wright, Architects. John Marion Roynon was the superintendent.

CASE STUDY 62

PROBLEM: Is a quadruplex classroom arrangement feasible?

APPROACH: In this case—a proposed elementary school—the basic considerations for the design were economy and the comfort of the children. The designers, therefore, were faced with two major questions: How can the school be constructed economically without sacrificing educational function or environmental comfort? How can classrooms be designed for maximum comfort in a hot, rainy region? It was agreed that there were four major ways to cut construction costs over the customary school layouts.

1. Make the proposed school more compact by cutting down the expensive perimeter.
2. Make use of outside corridors which can be constructed at at least one-half the unit cost of heated, closed corridors.
3. Design the building for use of repetitive structural units which can be quickly erected in order to combat the area's high labor scale.
4. Eliminate expansive parapets and house the educational program under simple umbrella type roof construction which rests on columns instead of load-bearing walls.

The designers were fully aware that because of the high humidity in this area, air movement during the hot school months was essential to comfort, even when it was raining. They also were aware that, if properly used, the sun in this region could be depended upon to provide good lighting conditions at no maintenance expense to the taxpayers. It was decided that full use should be made of the sun and wind for providing comfort in the proposed school.

SOLUTION: With these considerations in mind the designers arrived at the QUADRUPLEX scheme. The scheme calls for grouping four classrooms back-to-back with an outside corridor which circumscribes all four classrooms. The corridor roof serves not only as a shelter but also as a sun and sky control device which makes shades and the cost of maintaining shades unnecessary. Full open-fenestration is provided on two sides of each classroom, giving good natural lighting and natural ventilation, as substantiated by the Texas Engineering Experiment Station, whose services were secured to prepare tests and a full report on lighting and ventilation. The classrooms have an 8-ft. ceiling height.

Credits: This is the El Vista Elementary School for Port Arthur, Texas, designed by Caudill, Rowlett, Scott, Neff, and Associates, Architects. Z. T. Fortesque was the Superintendent.

CASE STUDY 63

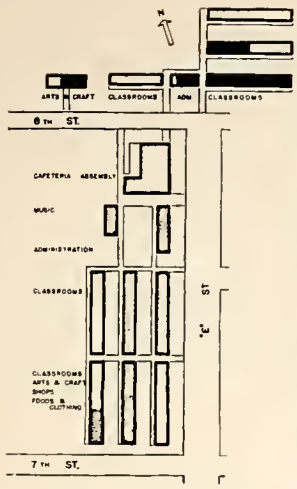
PROBLEM: Can the advantages of outdoor and indoor swimming pools be combined?

APPROACH: Looking on the project from the point of view both of school use and community enjoyment, it was obvious from the beginning that an open pool area rather than an indoor pool should be the starting point of the design. Both for psychological and practical reasons, therefore, in a community and a climate generally associated with indoor-outdoor living, it was desired to preserve the maximum natural values of the situation and still obtain the comfort and protection for continuous use.

The school site is in an area directly exposed to cold winds from the Pacific Ocean which often funnel down through an unprotected valley, sometimes recurring daily and normally reaching a velocity of 30 miles per hour. These winds are at their peak in mid-afternoon when the pool would be in greatest demand. Such conditions, however, are far from constant. The warm and sunny and fairly tranquil weather which can be enjoyed sometimes for a part of the day, or for longer in certain seasons, makes an open pool very desirable at such times.

SOLUTION: A scheme was developed for a convertible type of structure with a sliding roof which would allow as much openness as possible when desired. Even if it were closed entirely on certain days, for the comfort and protection of the users, it could be opened periodically for airing the interior. But in favorable weather it would guarantee the enjoyment of sky, sunshine and fresh air.

Credits: Capuchino High School, San Bruno, California; San Mateo Union High School District, Thomas F. Reynolds, Superintendent. Architect, John Carl Warnecke, A. I. A., San Francisco and Oakland. Photograph by Moulin Studio.


ARTS & CRAFT
CLASSROOMS
ADM
CLASSROOMS
6TH ST.
CAFETERIA ASSEMBLY
MUSIC
ADMINISTRATION
CLASSROOMS
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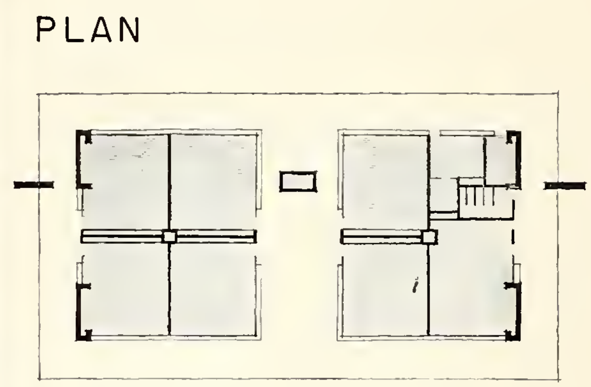
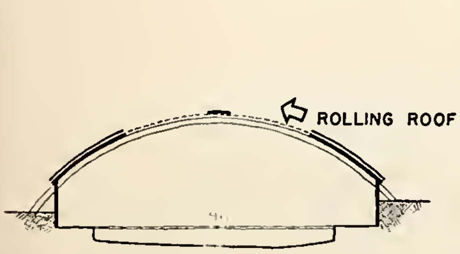
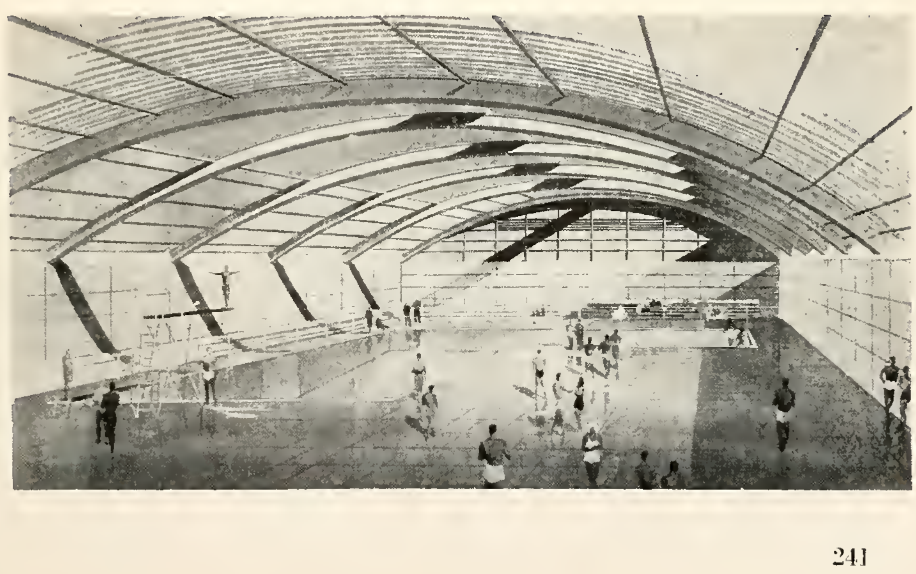
ARTS & CRAFT
SHOPS
FOODS &
CLOTHING
7TH ST.
"E" ST


PERSPECTIVE
PLOT


PLAN


ROLLING ROOF



CASE STUDY 64

PROBLEM: What kind of a layout is suitable for an area of heavy rainfall?

APPROACH: The problem faced by the planners was simply this: The rainfall for the area was heavy, too heavy (in their opinion) to take the chance of possible leaks in roof breaks such as clerestories, monitors, skylights, and plastic domes. Then what sort of a scheme would provide the good lighting and ventilation associated with these devices? In seeking an answer to that question, the planners finally arrived at a layout scheme which gave "umbrella" protection without the use of toplighting devices or clerestories. The layout turned out to be a combination of a double-loaded corridor scheme with a single-loaded arrangement having enclosed corridors. The architects secured the services of the Texas Engineering Experiment Station to make ventilation and lighting tests to determine the effectiveness of this plan. See sketch of the ventilation test. Note that the leeward classrooms open onto a court (A) which scoops up the breeze for proper distribution. Three different tests were made for natural illumination. The architects were anxious to achieve a residential "feeling" by having as low an eave line as possible, but did not wish to sacrifice lighting by doing it. So the three tests included the lighting performance for a 9-ft. eave, an 8-ft. eave, and a 7-ft. eave measure from the finish line to the bottom of soffit. The illumination readings above are for the 7-ft. eave test (B). The units are foot-candles (A).

SOLUTION: The final solution as shown here is essentially an umbrella roof over a single-double loaded corridor arrangement of classrooms. Large overhangs are provided on all sides of the building to throw the water away from the walls. Above 30 foot-candles of illumination are provided on even overcast days (1000 foot-lamberts) (Curve B). Each classroom has bilateral lighting. Each room has cross ventilation. And economy is achieved through the minimum cubage afforded by the 7-ft. ceilings on one side of each classroom.

Credits: This scheme was developed for the Port Arthur Elementary Schools, Port Arthur, Texas. The Architects were Caudill, Rowlett, Scott, Neff, and Associates. The Superintendent was Z. T. Fortesque.

CASE STUDY 65

PROBLEM: How can we improve the appearance and scale, and encourage multi-purpose use of playrooms?

APPROACH: The playroom for the elementary school is intended primarily to be used for the more informal sort of play of the lower and intermediate grades. Often enough, however, the playroom must, in addition, serve as an occasionally-used auditorium or meeting room and for community activities during non-school hours, and should be made adaptable for such uses. All these basic and related activities would be satisfied by a more informal and friendly room that would logically belong, inside and out, to a school plant purposely designed to the scale and needs of children of the elementary grades. Ways were studied of achieving a cheerful, well-lighted room where the feeling of the outdoors becomes an element of the interior design. Especially recognized was the importance of relating the location and proportion of window area to the particular functions and proportions of the room, both interior and exterior. For, on the exterior, the treatment of the window area could assure scale and design continuity between the playroom and the other elements of the building, and on the interior provide pattern interest and space variety of exterior related to interior, while acknowledging the practical aspects of relatively high windows in a room meant basically for free physical movement.

SOLUTION: In addition to using warm and attractive colors and materials, the providing of high, yet ample, areas of glass connecting low, full-height glass areas in the corners of the playroom accomplishes a pleasant and effective balance between the appearance and proper functioning of the room. The ample glass areas, aside from assuring good daylighting, open the scale and space of the room to the outdoors. In particular, the low, full-height glass in the corners of the room makes possible a view relating the scale and sense of things outside to the interior, while freeing the end walls from the side walls and thereby creating a feeling of less confined space. Also, the light coming through these low corner windows focuses on the portable stage placed against the end walls when the room is used during the day as an auditorium. Yet, being in the corners, the low glass areas are in that part of the room where the least physical movement will occur when the room is used for its basic playroom functions.

Credits: This is the Hoover Elementary School, Neenah, Wisconsin, designed by Perkins and Will, Architects. The Superintendent was Harold Mennes. Photography by Hedrick-Blessing.

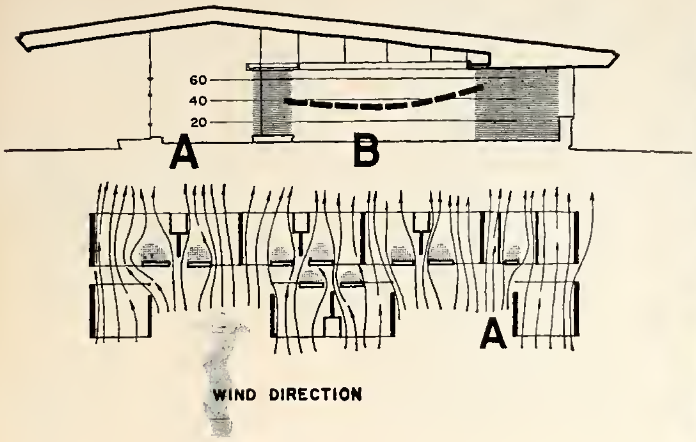
CASE STUDY 66

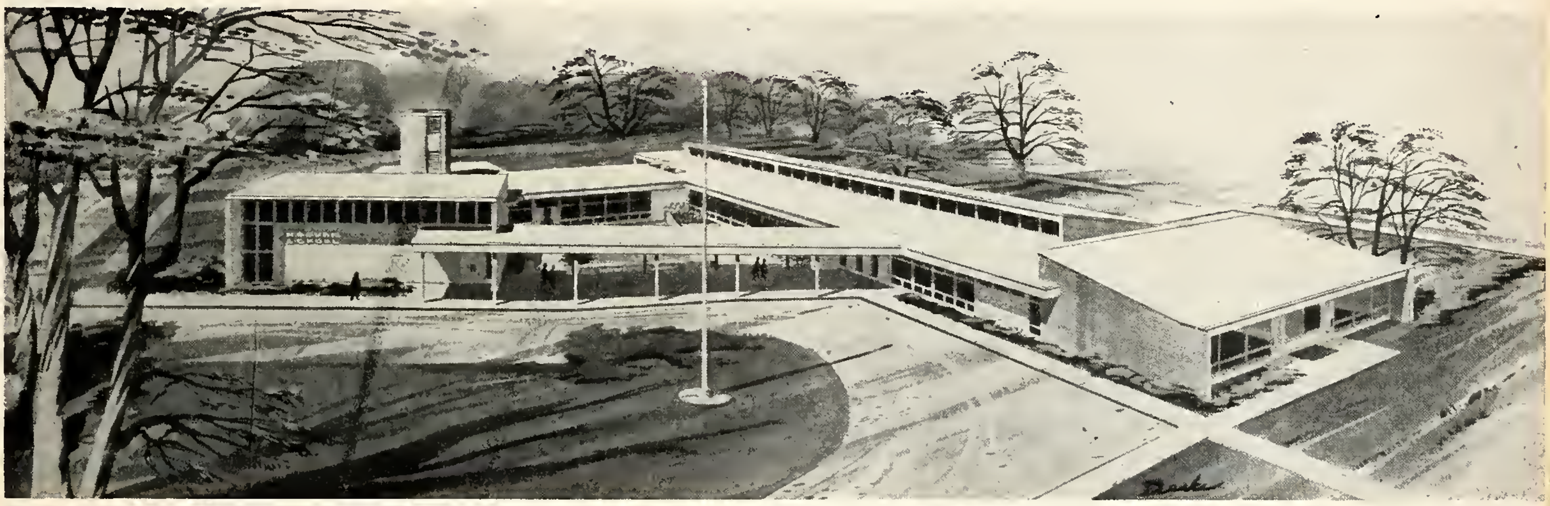
PROBLEM: How close can we come to ultimate flexibility in practice?

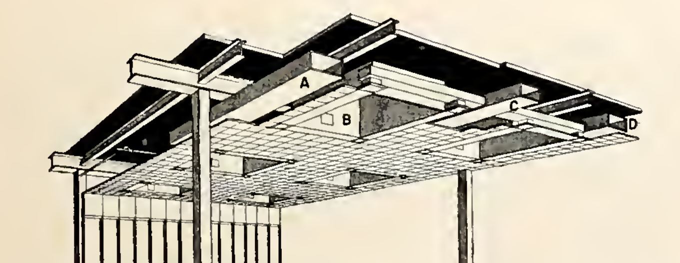
APPROACH: The school building committee, in formulating the educational program for this new secondary school, wanted the school faculty to have the power to shape its school plant to meet any changes in educational program that might develop. The demand was for "accordion partitions." Teaching spaces might need to be altered to almost any dimension, proportion or relationship. The first observation was that the usual reliance on exterior walls and windows for light and ventilation would impose almost unworkable limitations. The roof, which often functions only to provide weather protection, seemed to offer an opportunity to provide as well a means of both daylighting and ventilating. If the roof could be so used, then partitions could be moved almost without limit in any direction.

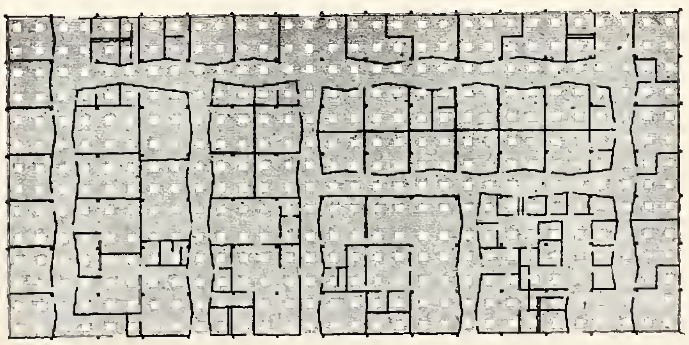
SOLUTION: A diffusing panel of glass block was selected as a source of top light, since it provides a light source as non-directional as possible with maximum diffusion, and one having a minimum roof area. This daylight is brought into the teaching area through a small light well(B); the architect wanted to keep this light well and the roof light panel small so as not to interfere with partition locations.The well was needed because of the depth of utility space between roof and ceiling required by air ducts (A.C.D.). Each light well is circled with sources of both artificial light and ventilation; as many such sources as possible were wanted so that small rooms at any location would have light and ventilation. A constant ceiling height in all areas was also wanted so that uniform partition panels would provide the means of dividing the floor area into varied arrangements. Commercially available partition units were used and are attached to floor, ceiling and adjacent units. The roof structure is supported on columns located on a grid of 28 ft. in both directions. A thermostat is placed on each column to control temperature in the adjacent bay. Any room larger than one square bay will have several controls to provide adjustment; rooms smaller than one bay must share the same temperature with the other room or rooms in the same bay. This ventilation, not being dependent on windows and the wind, is a minimum distraction to the teacher who does not have to operate windows, and it is positive at all times.

Credits: This school is the Hillsdale High School, San Mateo, California. John Lyon Reid was the Architect. The Superintendent was Thomas F. Reynolds.


60
40
20
A
B
A
WIND DIRECTION




A
B
C
D



CASE STUDY 67

APPROACH: Can dining and reading spaces be combined?

APPROACH: The approach taken by the planners was something like this: They had a junior high school to do. From the very start they knew that certain compromises were necessary because there was not enough money to go around for separate cafeteria, auditorium, and gymnasium. These planners were aware of the many types of multipurpose rooms, but they did not like any of the combinations they had seen. For one thing, when the cafeteria was combined with either the auditorium or gymnasium, there was the great problem of moving and storing tables and chairs. Even the fold-into-the-wall table and bench scheme was not a satisfying solution to the problem. They did not like the idea, either, of having a half-breed room that serves neither as a good auditorium nor a good cafeteria. They believed that an auditorium scientifically designed for good hearing and seeing was essential to the educational program. They also believed that a gymnasium was essential and no compromises would work. Yet certain space combinations were necessary because of cost limitations. After much study the planners arrived at a "happy compromise." Why not combine the reading room of the library and the dining area of the cafeteria, and provide separate auditorium and gymnasium? The type of furniture is exactly the same. So it was decided that spaces for dining and reading had educational compatibility. And such a combination was economical!

SOLUTION: The solution provides for a dining-lounge type room adjacent to an entrance social court. The serving line of the cafeteria is across the corridor. The open book stacks are on two sides of the room. The architects were very careful in the design of this room to make it one of the most comfortable, pleasant spots in the school plant. The room has floor-to-ceiling windows, which open onto the greenery of the social court. Besides dining, reading, and lounging, the room also serves as an overflow space for the auditorium.

Credits: The scheme was developed for the recently constructed junior high school in Electra, Texas. The school was designed by Caudill, Rowlett, Scott, and Associates. Gerald Barber was the Superintendent of Schools.

CASE STUDY 68

PROBLEM: Is the central kitchen feasible?

APPROACH: Thousands of dollars annually are spent for expensive kitchens in small schools. In order to cut down first cost as well as operation cost, the central kitchen idea is becoming more popular each day. The idea has been accepted particularly on the west coast. The scheme shown here was developed by architect Henry L. Wright who has this to say about the case for a central kitchen: "It takes less floor space to provide a small service kitchen at each school building. Fewer items of kitchen equipment are required. Only part-time help is needed at each school service kitchen. In some cases a parent with student help will serve the food during the noon hour and clean up afterwards. Of course, the central kitchen idea works only when one simple menu is served at all schools in the district." Where economy is necessary to carry out an effective school lunch program the central kitchen is feasible, as the solution described below will show.

SOLUTION: The plan provides for a food cart as shown here, which can be transported from a central kitchen to a service kitchen which has a slot in the serving line (arrows) as shown in sketch above. The plan is to transport the food a half hour or so before lunch time to each school. The prepared food is stored, transported, and served from this lunch cart. Food is served on divided trays and milk is dispensed in a container with a straw. There are no water glasses, and drinking fountains are provided in the dining space. When the lunch period is finished, the divided trays and silver are washed and stored at the individual school. The pans containing the food are replaced in the food cart and sent back to the central kitchen for cleaning. The service cart is designed to hold approximately 350 meals. One compartment is unheated and is used to store salads, jello, desserts, etc. This compartment remains at room temperature, and any food requiring chilling is removed from this compartment upon arrival at the school and placed in the refrigerator in service kitchen, which is also used as storage for the milk which is delivered to each school.

Credits: This plan was devised in the offices of Kistner, Wright, and Wright, Architect-Engineers for the Norwalk School District near Los Angles, California. The Superintendent of Schools was Reginald M. Benton.

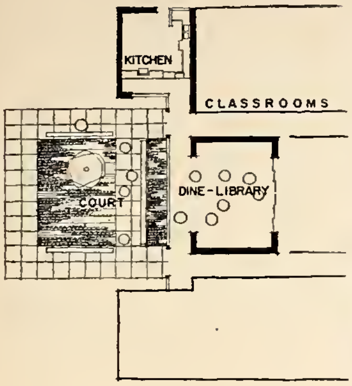
CASE STUDY 69

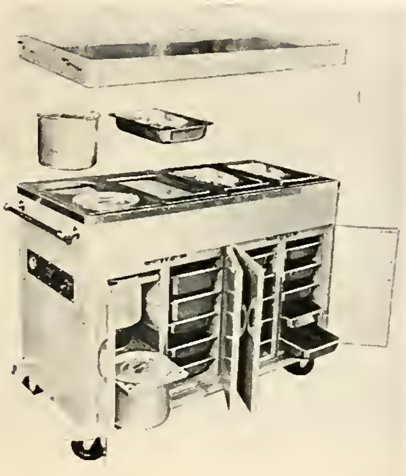
PROBLEM: What is a practical method of audio-visual blackout for standard classrooms?

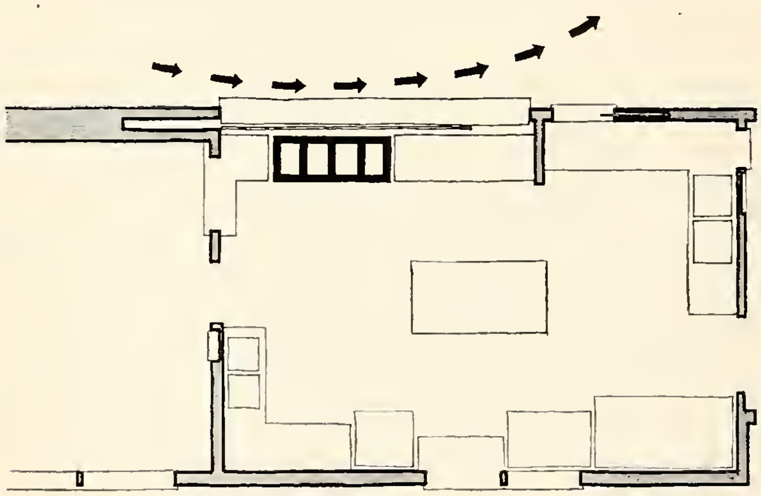
APPROACH: The designers' purpose was to get away from the usual method of darkening classrooms—drawing curtains over the windows —because curtains flutter in gusts of air, block ventilation, and, even when not in use, decrease the daylight in the classroom.

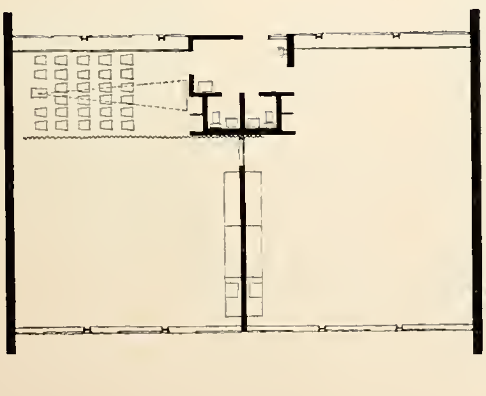
SOLUTION: An interior line of drapery (a) which, when pulled out, creates a separate audio-visual area and excludes from this area the light from the main windows of the classroom. The section of the classroom that remains daylighted can be used simultaneously for other activities. In the audio-visual area, the secondary window wall is equipped with vertical sliding doors (b) that serve as tackboards. When drawn down, the tackboards cover coat cubicles located beneath the windows, replacing wall space that normally would be lost. When the tackboards are raised they black out the windows. On occasions, the interior drape can be used effectively as a movable "partition."

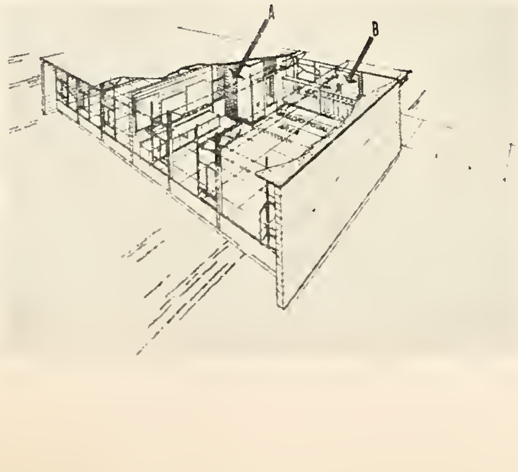
Credits: This is a proposed new elementary school for the town of Dairen, Connecticut, designed by Ketchum, Gina, and Sharp, Architects. The Superintendent is Sidney P. Marland, Jr.


KITCHEN
CLASSROOMS
COURT
DINE-LIBRARY








A
B

CASE STUDY 70

PROBLEM: How can appearance and scale of double-loaded corridors be improved?

APPROACH: Double-loaded corridors, like tunnels, can be rather dull and long spaces, even if well illuminated and basically attractive. The introduction of display areas, pleasant illumination, and various interesting surface treatments and details can do much to relieve the monotony of expanses of lockers and the inherent awkward spatial proportions of a school corridor. Ample classroom entry spaces opening off the corridor help achieve the very important result of relieving the channeling effect of the opposite walls and add a feeling of greater spaciousness to the corridor; for space pattern belongs with surface pattern, and more emphasis on space relations became the answer to relieving the enclosed and separated feeling between corridor and classroom.

SOLUTION: By building the lockers or built-up wood wardrobe units in effect as low standing partitions between the corridor and classroom, with no full height wall behind them, the sense of space and spaciousness is carried from the corridor into the classrooms on either side. The open area above the lockers can be glassed in or not, whatever the amount of corridor traffic and accompanying sound problems may warrant. Walking along the corridor affords pleasant glimpses into the classrooms and the feeling of the corridor as a friendly aisle between the classrooms and not an island passage separated from their lightness and color. The students in the classroom can look out to the corridor space and sense they are part of a larger group community and not isolated in their separate room. And yet, the height to the glazed or open area from the floor and the sight lines of the pupils within the classrooms are such that the corridor traffic does not disturb those in the classrooms. This feeling of corridor merging into classrooms also permits the corridor ceilings to be lowered closer to the scale of the children without the ceiling's seeming uncomfortably low, for the scale of the corridor space is sensed beyond its actual limits. Over-all, the result is a more cheerful corridor of sustained and varying interest, and while the functions of the two elements are still distinctly separated, there is a visual unity of space and sense of community feeling between the corridor and classroom.

Credits: This is the Blythe Park School, Riverside, Illinois, designed by Perkins and Will, Architects. The Superintendent was Ludwig J. Hauser.

CASE STUDY 71

PROBLEM: How can you eliminate the floor space generally used by a platform in a multi-purpose room?

APPROACH: The multi-purpose room is used for dining, assembly, and all kinds of games and dances. A platform is always necessary in order that the full use possibilities of such a room may be exploited. This platform occupies a considerable floor area; and the time of its use is often small compared to the intense use of the room floor area. In order to get fullest value out of the platform area, it often serves for functions which could be better cared for on the floor of the multi-purpose room. The requirements of the average users of this platform are generally quite modest; even the amateur actors do not always need footlights and the other paraphernalia of the stage.

SOLUTION: In many schools (not all, mind you, but many) a simple elevated floor area about 12 ft. by 20 ft. would suffice as a platform when the room serves for assembly purposes. This is especially true if there is another nearby auditorium which can accommodate the more complex demands of stagecraft. The heating and ventilating equipment of the small multi-purpose room occupies approximately 12 ft. by 20 ft. of floor space. The ceiling height of this mechanical room may often be less than the multi-purpose room of which it is a part. So the architects elevated the floor of this mechanical room, eliminated the waste volume of unused ceiling space, and found that they had room under it for a rolling platform, 30 in. high. This is mounted on large casters, and it can be rolled in or out of its storage space by one man. The casters are guided into the storage space by light metal tracks. Portable steps give access to the platform.

Credits: This is the Buri-Buri School of South San Francisco, Calif. designed by John Lyon Reid, Architect, San Francisco, Calif. The Superintendent was James C. Cherry.

CASE STUDY 72

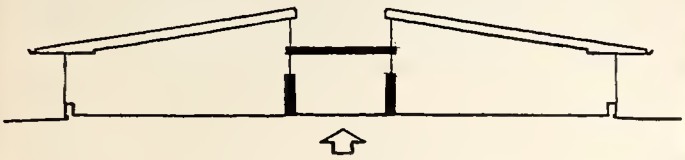
PROBLEM: How can special purpose facilities for an eight classroom unit be designed to take care of an 18-classroom unit?

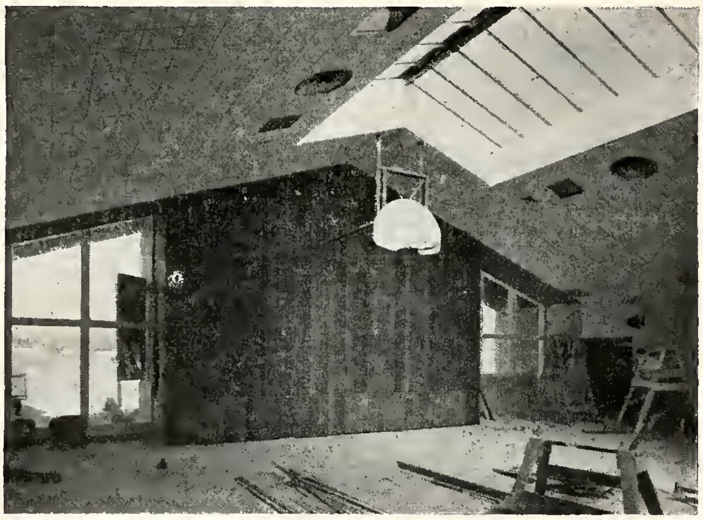
APPROACH: Although a 10-room addition was to be built in four years, school officials wanted a complete functioning educational unit with all the necessary facilities in the first unit. Funds were limited for this project because of other needed classrooms in other parts of the school district, so the special purpose facilities had to be cut to a minimum to keep within the money available. The problem was further complicated by the fact that while there would be a school secretary, the principal would teach full time and the nurse would be assigned to this school building only two days a week.

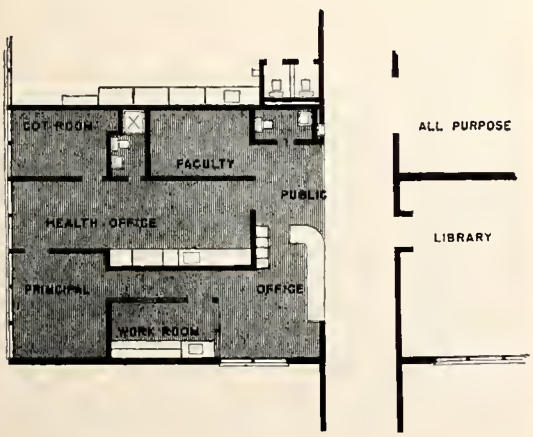
Administrators, teachers, parents, and State Department of Public Instruction people helped to set up the educational specifications for the building. The architect employed to design the building sat through these meetings and participated in the discussion of the problem involved. A number of problems that the designer would have to solve were brought out in these meetings. It was pointed out throughout the meeting of these committees that flexibility and expanse of these facilities were very essential.

SOLUTION: Consequently, all partitions in this space are movable, and by simple changes the facilities can be made adequate for an 18-classroom unit. It is planned to move the faculty room, work room and conference rooms into the space that is occupied by the library in the first stage of development. The library would be relocated in another part of the building and complete library facilities would be included when the 10-room addition is constructed.

Credits: This is the Martha Lake Elementary School, Edmonds, Wash. designed by William Arild Johnson and Associates, Architects. John W. Goddard was Superintendent of Schools. Harold Silverthorn was the educational consultant.






COT ROOM
FACULTY
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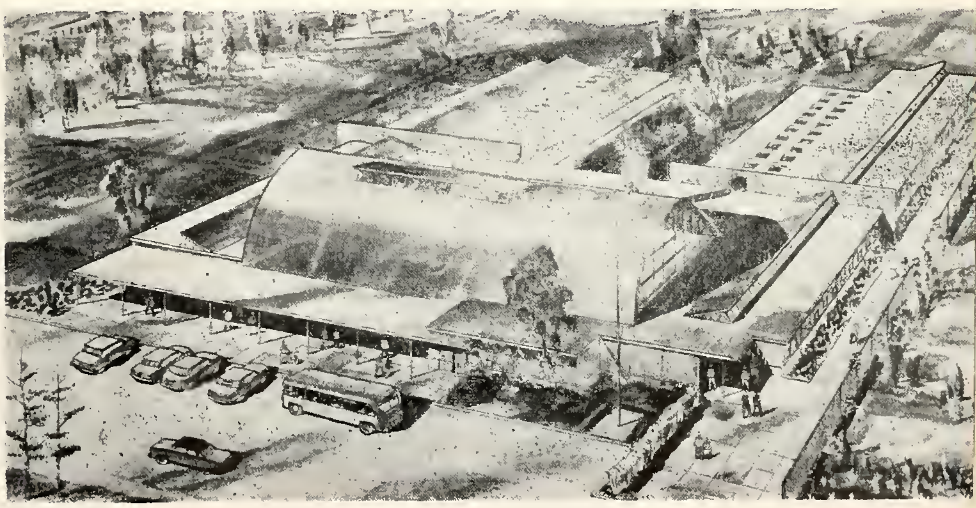
WORK ROOM
ALL PURPOSE
LIBRARY



CASE STUDY 73

PROBLEM: Can an auditorium lobby have a multi-function?

APPROACH: This question came up during the planning of an auditorium for an elementary school. In the early stages of planning it was concluded that space used only as a lobby of an auditorium would be used but very little during the typical school day. Limited funds for the building program made it necessary that all space be used for education. After considerable study, the planners decided upon a scheme that gave the lobby a much more important part than just space to mill after an auditorium performance.

SOLUTION: The final scheme for this multi-function lobby calls for the space to serve as:

1. A lobby for the activities of the auditorium
2. An exhibit hall for the school
3. A showcase for night exhibits.

As the sketch above shows, the auditorium is a windowless brick mass and its lobby is in essence a glass showcase. It can be lighted up at night like a well-lighted automobile display room. Its use is particularly adapted to school displays for Scout Week, Christmas, Easter, F.F.A. celebrations, and school festivals. The development of these displays could be an integral part of the school program. On the inside of the lobby there are permanent display cases for trophies and art work.

Credits: This scheme was developed in connection with planning the Washington Elementary School in Blackwell, Oklahoma. The architects were Caudill, Rowlett, Scott and Associates. The Superintendent was J. Arthur Herron.

CASE STUDY 74

PROBLEM: Can very large assembly space be multi-functional?

APPROACH: The architects of this project were confronted with the very difficult problem of designing assembly space with tri-purpose. The requirements were as follows:

1. Inactive assembly for 2000. Such space must have good acoustics for general auditorium use, the best sight lines for dramatic performances, and be equipped with projection booth.
2. Active assembly for 1500. Such space must have level floor and flexible seating for dances, banquets, and festivals.
3. Sport spectator type assembly for 1000. This space must provide comfortable seating and good sight lines for basketball, volleyball, tennis, and other games which can be played indoors.

The approach to solving such a complex problem was made through bringing in many specialists, including an acoustical engineer and a stage specialist under the leadership of creative architects.

SOLUTION: The seating requirements were met by providing 1500 on the level floor and 500 in a mezzanine. Storage for the movable seats and collapsible bleachers required for sport activities, dances, and banquets is under the stage and front of mezzanine. The acoustical difficulties were solved by providing one rough side wall to compensate for the opposite glass wall (see the sketch) and an undulating ceiling which diminishes in height as well as the percentage of reflective surface as it recedes toward the mezzanine. Low frequency sounds are absorbed by sloping plywood walls at the rear of the auditorium. Poor sight lines necessitated by level floor were overcome somewhat by raising the front edge of the stage higher than usual and sloping the stage floor slightly. The projection booth was suspended from the ceiling to save valuable seating space.

Credits: This scheme was developed for the Community Auditorium at Brownsville, Texas. Wiltshire and Fisher were the architects. The acoustical engineer was Wayne Radmose and the stage specialist was Paul L. Walner.

CASE STUDY 75

PROBLEM: Is a campus school layout desirable for northern climates?

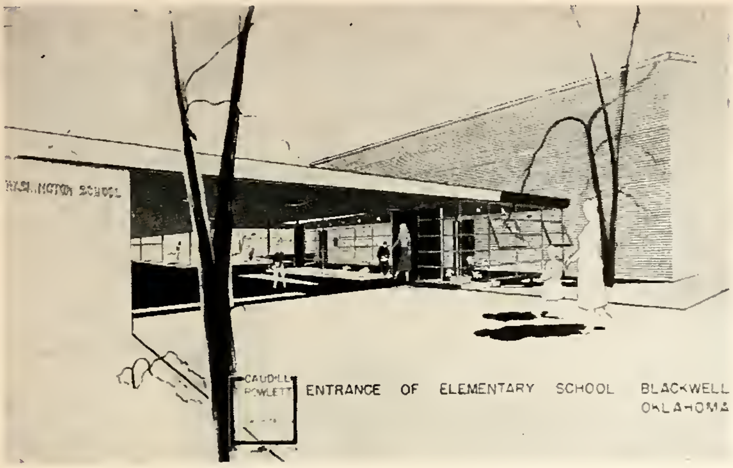
APPROACH: Although every effort has been made to cut non-educational space to a minimum consistent with sound administration, most schools have non-educational space which costs taxpayers the amount of the contractor's bill for labor, materials, services, and fees. Corridors, for instance, are used mainly for getting elementary school children to and from the classrooms.

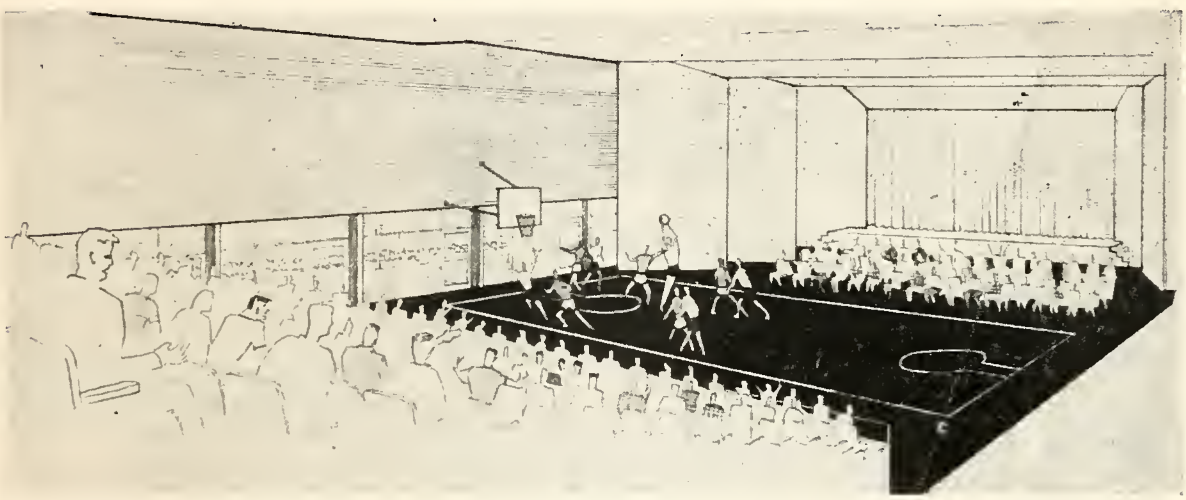
The elimination of classroom corridor became a major target after these facts were verified:

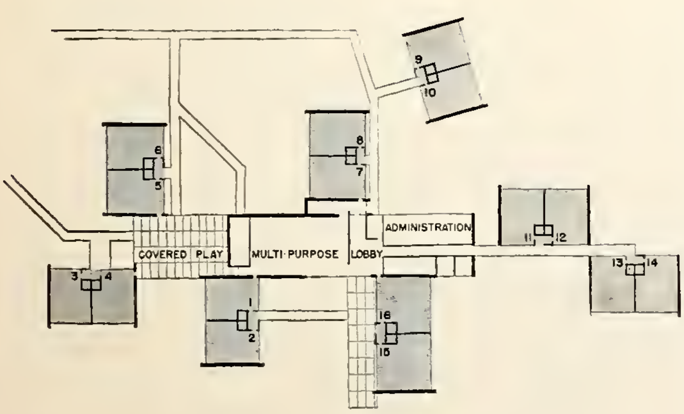
1. The town, in operating an abandoned elementary school on a temporary basis, was obliged each day to send the students to the nearest school with lunch and playroom facilities (a distance of five blocks). No hardships were encountered.
2. In all the other elementary schools, students take their outer clothing with them to the lunch room in order to spend the balance of the lunch period out of doors without having to return to the classroom for these articles.
3. The most tightly planned double-loaded corridor scheme that could by developed for this program proved to be nearly 30 per cent greater in area than the campus type scheme shown herewith.
4. Because of an extremely hilly site, no one-level single- or double-loaded classroom areas could be placed without considerable extra cost for deep footings, additional excavation, or both.

SOLUTION: Something close to ideal daylighting of all classrooms has been incorporated without having to resort to use of high ceilings or clerestories, thus substantially increasing the savings in labor and materials already gained through corridor elimination. Because of the duplication of the domestic-scale two-room units, smaller local contractors have expressed interest in bidding, which means that there will be more intensive competition for the work. And there are no corridors!

Credits: This is a proposed new elementary school for Darien, Connecticut, designed by Ketchum, Gina and Sharp, Architects. The Superintendent is Sidney P. Marland, Jr.


WASHINGTON SCHOOL
CAUDILL ROWLETT
ENTRANCE OF ELEMENTARY SCHOOL BLACKWELL OKLAHOMA




COVERED PLAY
MULTI-PURPOSE
LOBBY
ADMINISTRATION
1
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CASE STUDY 76

PROBLEM: How can the use of the classroom be freed from restrictions imposed by daylighting?

APPROACH: The planners of this building did extensive basic research into daylighting and other elements of the problem. The following findings pointed to the solution: Daylight is a variable, hence, to control it, there needs to be a compensating variable, (a light valve consisting of louvers opening and closing as the daylight change). These louvers are controlled by a reversible electric motor which is controlled by photo-electric cells. The eye is built for overhead light, hence that is the main source. Light from the side is disturbing and indicates that windows are not to be the light source, but rather used for view out or in. When daylight (consisting of sunlight and skylight) is brought through a light processing chamber, completely diffused and its quantity regulated, a very desirable light condition results which eliminates eye strain and harm to posture. Along with this, is the educational advantage of complete freedom from 'facing' or grouping the students. It further frees the orientation of the classroom completely.

SOLUTION: After experience, the light level was set at 175 foot-candles at desk height. Electric lights, also controlled by photo-electric cells, switch on when the daylight falls below 50 foot-candles and off again when the daylight rises above 70 foot-candles. The planners of this school recognized that a by-product of the controlled daylighting system readily permitted low exterior walls. This was a direct saving in cost and in operation and maintenance. From the child's point of view, something low is more to his liking (the child is our true client). An educational objective has been gained. This more than paid for the mechanical control of the daylight and additional cost of the skylighting and plastic ceilings. Outside walls of classroom and corridors were reduced to about 8 ft., saving a wall area of 35 percent throughout the building.

Credits: This is the Southgate Elementary School, South Central School District 406, Seattle, Washington. Ralph H. Burkhard was the architect. The superintendent was Donald J. Cady. The photography was by Dearborn-Massar.

CASE STUDY 77

PROBLEM: What form of concrete building frame is most simple and economical?

APPROACH: Space arrangement studies showed that a classroom area approximating a square in shape was the desired plan proportion for the room. The usual column and beam form of concrete construction, or a concrete pan design, would require expensive form work and shoring, and would additionally require a suspended ceiling to cover up irregular surfaces which would lower light intensities and be visually distracting. Instead, the architect wanted a smooth slab that would reduce the construction of forming to a minimum, which would allow the maximum of window glass without interference by beams, and which would in itself form the finished ceiling. Sound conditioning in the form of acoustical tile could then be applied directly to the ceiling slab. Could a system of forming be designed that was primarily simple and which permitted maximum re-use of the same form structure? This approach led the architects to a beautiful, functional classroom shape.

SOLUTION: In this school, the teaching staff wanted the room dimensions to remain fixed without provision for future partition change, so that the separating partition between rooms could be considered permanent. This suggested the use of this wall slab as a column to support a slab roof structure without beams. The sloping of the slab upwards and away from the wall column, instead of a horizontal roof slab, reduced considerably the bending moment which occurs at the joint of wall and roof; the opposing similar slab on the opposite sides of the wall offered a balancing moment. Thus the structural unit became a Y form. When structural units were joined they formed a series of gabled rooms, with a pin connected joint of zero moment at the ridge. This resulted in the unique shape of the building, essentially a series of connected gables, the ridges and valleys at right angles to the longitudinal direction of the building.

Credits: This is the Sir Francis Drake Elementary School, San Francisco, California, John Lyon Reid was the architect. The superintendent was Dr. Herbert C. Clish. Engelhardt, Engelhardt & Leggett, Educational Consultants.

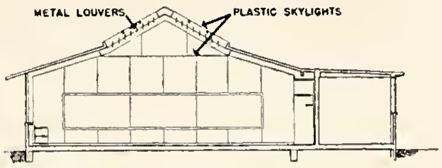
CASE STUDY 78

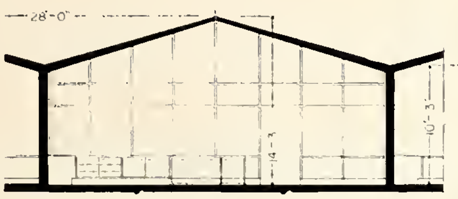
PROBLEM: How can we achieve a rational method of corridor storage of outer clothing for elementary grades?

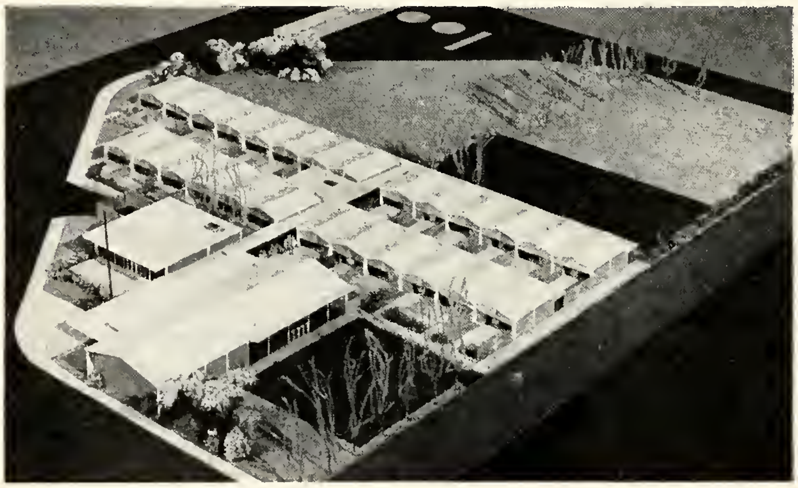
APPROACH: The preference for metal lockers for clothing storage in elementary schools is sometimes a matter of established school management policy or just plain habit. In the upper elementary and higher grades, metal lockers are practical where the students begin departmentalized study and keep their equipment and clothing in a centrally located locker. In the lower grades, however, the student's day is largely spent in one room; his study equipment is limited and usually with him in the room. The need for locked storage is therefore much less necessary. The theft problem is insignificant. The cost of school buildings, however, is always important.

SOLUTION: Open wardrobe units made of wood were designed that satisfied the clothing storage requirements for the elementary grades and proved more economical than metal lockers even though custom-made to fit the particular installation. The units were built to the scale and needs of the students, and in harmony with the design character of the entire school. The heights of the wardrobe units were varied to suit the various age groups. Coat hooks were provided and vertical wood baffles were used to divide the cost spaces into groups. The grouping aided recognition and relieved design monotony. An upper shelf was provided, also a lower shelf that doubles as a bench for sitting while tugging on the overshoes that are stored in the cleanable space below. The units' being open minimized ventilation problems, and the children's coats hanging side by side added their gay color and human interest. Such wardrobe units become an integral part and an enhancement of the building design.

Credits: This is the Barrington Countryside Elementary School, Barrington, Illinois, designed by Perkins and Will, Architects. The Superintendent was Mrs. Jean McGaughy.


METAL LOUVERS
PLASTIC SKYLIGHTS


28'-0"
14'-7"
10'-3"
TYPICAL CLASSROOM SECTION



CASE STUDY 79

PROBLEM: Can corridors be eliminated?

APPROACH: The approach to this design stems from the architect's conviction that schools should be built around human values. He asks the question, "School plants can be marvelously efficient, beautifully engineered, but what about the relationships between students and between teachers as humans; are they served as beautifully as the functional requirements?" To this deep-thinking architect a corridor to a bunch of cells is not an ideal handling of pupil environment. Classrooms should be interrelated and should provide a closeness, family-style operation of classrooms for teachers and pupils; contrast with the hotel-style corridor and rooms, where no one knows or cares about anyone else. The architect gives further evidence that corridors can be eliminated. He reasons that in pupil-hours the amount of passage required in an elementary school is negligible while the corridor space is useful at all times. How do the savings, if any, compensate for the nuisance caused by thru classroom circulation? The architect's answer to these: "Percentage space saving of roughly ⅓ of classroom cubage (single loaded schemes) pays for small nuisance factors, likely to be soon forgotten." This kind of thinking led to the corridorless school above.

SOLUTION: The scheme is a quadruplex arrangement—four classrooms for "family-style operation" in a free-flowing space arrangement. There are no doors, just screens which serve as teaching devices and storage units. The sink and drinking fountain and work station at the center can be developed into a friendly meeting place between room spaces. The teaching station (source of majority of noise) is located at opposite ends for reduced noise interference. This four-classroom unit can be combined in many ways with coro units to build up a small city of neighborhoods with interesting vistas and courts that result in a "dispersed" school of an intimate scale though capable of reaching a fairly large size.

Credits: This is one of the schemes developed for the proposed eight-room addition of St. Rose of Lima Elementary School, Houston, Texas, designed by Donald Barthelme and Associates. The pastor was Rev. Paul C. Pieri.

CASE STUDY 80

PROBLEM: Is the conventional teacher's desk the best solution to the teacher's work area and storage problem?

APPROACH: A well-known educator once said, "The teacher's desk at the front of the classroom is one of the worst evils of education." He points out that the very existence of the desk forces formal teaching and that it symbolizes strict discipline. More and more as the informal activity program comes into full play in the school program, the standard teacher's desk becomes less and less desirable. It was this kind of thinking that led the planners of this school to abandon the so-called teacher desk in favor of an integrated work and storage unit.

SOLUTION: The scheme for solving this problem is a built-in counter space running the length of the classroom wall. See plan and photograph (right). Files and drawers are contained in this lockable area. The teacher's personal belongings would be kept in this desk. This solution eliminates a set direction in the arrangement of the room and, following modern teaching methods, any piece of furniture in any part of the room can then serve as a center from which the teacher directs class activities.

Credits: This teacher's facilities scheme was developed by Ketchum, Gina, and Sharp, Architects, for the Holmes Elementary School, Darien, Conn. The Superintendent of Schools was Sidney P. Marland, Jr. Photography by Ezra Stoller.

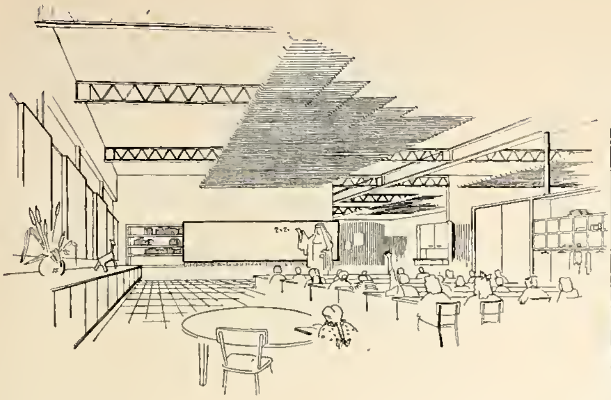
CASE STUDY 81

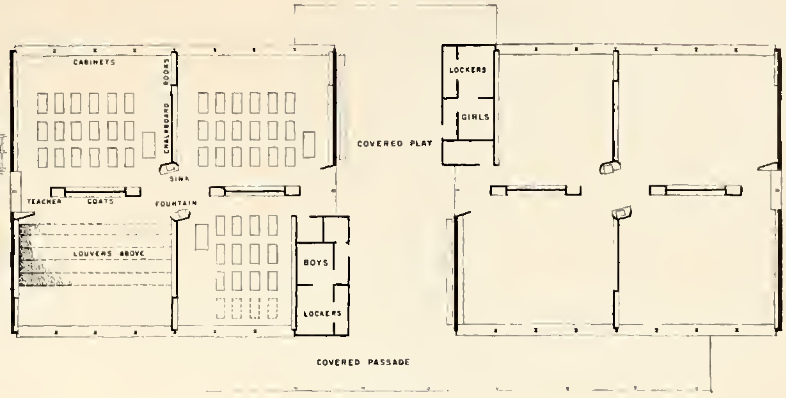
PROBLEM: What type of classroom will best suit small group activities?

APPROACH: With the belief that it was possible to dramatize the feeling of space and scale in a classroom by varying the ceiling height, it was thought that another ceiling plane could be arranged that would have the effect of suggesting room divisions or zones without lessening the necessary unity of the floor surface. The shape of the room as determined by the walls might then be related to the varying ceiling planes to provide open alcoves. Classroom activities, in general, formed themselves into three broad groups: manual work of a high degree of activity such as painting, work with clay, building work, reading, writing, and study; small discussion or special study groups. This suggested a classroom arranged in recognition of these groups.

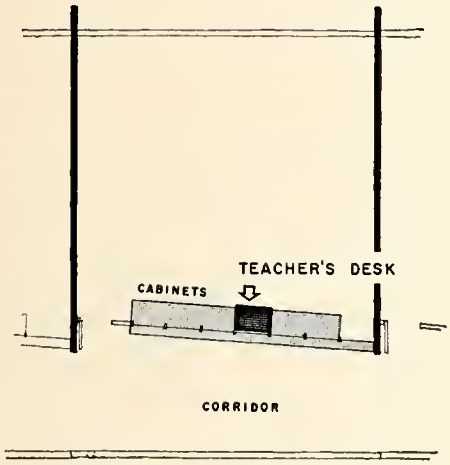
SOLUTION: Changing ceiling planes had to be designed in terms of a simple and repetitive structural scheme. The lowest height that would be suitable for group use was established at approximately 7 ft. 6 in. Since this height, by limiting the window area on one wall, would correspondingly limit the penetration of daylight into the room, the architect fixed the height of the other ceiling plane so that a supplementary band of clerestory windows would furnish daylight to the center of the classroom space. This gave two ceiling heights and suggested that the lower height would be appropriate for a small space for the smaller groups of children who would undertake special studies or engage in discussion work. There was an unexpected dividend here when it was found that a curtain track located at the inside line of the low ceiling under the clerestory windows divided this space even further so that it would be used as a dressing alcove for classroom drama work or serve as a small separate room where the curtain was drawn. The area under the high ceiling then naturally divided itself into an area for large groups, and at one end there was a workshop area with work counter, opening directly into an outdoor classroom. The corner of the alcove wall in the classroom provided an informal division of the workshop area and large group area. The alcove wall was slanted to provide the greatest unity to the classroom floor surface and to permit the teacher to observe easily her entire class.

Credits: This is a classroom of the John Muir School, Martinez, Calif. John Lyon Reid was the Architect, and the Superintendent was Willard B. Knowles.

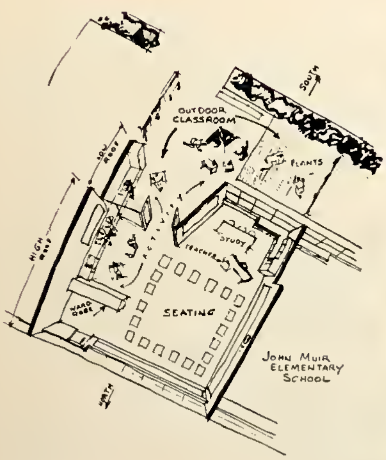




CABINETS
BOOKS
CHALKBOARD
SINK
TEACHER
COATS
FOUNTAIN
LOUVERS ABOVE
BOYS
LOCKERS
COVERED PLAY
LOCKERS
GIRLS
COVERED PASSAGE



TEACHER'S DESK
CABINETS
CORRIDOR



OUTDOOR CLASSROOM
PLANTS
SOUTH
STUDY
SEATING
JOHN MUIR ELEMENTARY SCHOOL

CASE STUDY 82

PROBLEM: How can a gymnasium be subdivided for both boys' and girls' activities?

APPROACH: The initial approach to this problem was derived from the complexity of the problem itself. The program for the new high school building had called for one large gymnasium which could be divided into two separate gymnasiums, with a maximum of locker room space and floor space for all athletic activities.

The architects began their approach with research of conventional, precedented means for solving the problem. It had been decided that their device must take the form of some sort of door; it was the type with which they were concerned. Such a door should be automatic, safe, sound-resistant, economical, easily maintained and durable. When in an open position, it should offer the minimum of obstruction to the spectator's view. This latter requirement eliminated many different makes of horizontal sliding doors. Cost and the size (100 ft. wide and 30 ft. high) discouraged the use of other makes. Those types which did minimize the loss of view and were in the low cost field were eliminated on the points of operation and automatic controls.

At this point it was reasoned, "Why must such a door slide horizontally? It could slide up and down." Research had not revealed any such door arrangement, but it was believed that a solution lay in that premise. Therefore, research was abandoned within the educational prototype, and they turned to the industrial field, where the answer was found.

SOLUTION: A set of six vertical up-sliding aluminum rolling curtain industrial doors was found to be the solution. Four of the doors separated a large gymnasium into two smaller gymnasiums; the remaining two doors separated the spectators' gallery. With the exception of narrow door guides, which stack at the side of the gymnasium, the view is unobstructed. Operation is fully automatic and safe. Noise resistance is satisfactory. Maintenance, due to the nature of the material, is minimized; durability is lengthened for the same reason. Construction renders the curtain flexible and resilient, thereby reducing injury from body contact. Mounted on the bottom flange of the main truss, the complete unit cost amounted to less than that of a conventional sliding door.

Credits: This is Birmingham High School at Birmingham, Michigan, designed by Swanson Associates, Architects. Dwight B. Ireland was Superintendent.

CASE STUDY 83

PROBLEM: How effectively can skylights be used to achieve 100 per cent utilization of space on a small site?

APPROACH: Although this school is located on a comparatively small site, its purpose is to alleviate crowding and to continue to provide for growing needs, to obtain the maximum facilities that space will permit, and to maintain minimum construction time, since occupancy was desired a year from the date of beginning the architectural drawings. Self-contained indoor-outdoor classroom units were specified, three units reserved for kindergarten use. Because relationships on these grade levels are interpreted as an extension of the home, each classroom unit was to express similarity to a home and yard as far as possible—basic needs being space, light, flexibility, storage room, and economy. In over-all design, the facilities were to blend architecturally with the existing school and neighboring homes in this closely-built section. The approach to the problem was to develop a whole series of studies in which were evaluated alternate schemes for use of the site. These schemes varied greatly; the first resulted in three (or four) separate buildings; the remainder had all units under a single roof, although not always in a single building. By working with these schemes in close collaboration with superintendent and the school board, the architect eventually arrived at a new scheme which combined all the advantages of the others and had something we believe is entirely new.

SOLUTION: The final scheme actually succeeds in obtaining practically 100 per cent educational use of the entire ground area, giving a total solution in terms of the best type of California indoor-outdoor planning, with both open and covered play areas accessible to each room. Except for two rooms which are directly adjacent, the classrooms are all separate insofar as their walls are concerned. The feature of the plan is a long skylight, running the entire length of the site, which ties together the separate units into a coordinated whole. Thirty-five feet wide, this skylight covers nearly a third of the area and provides a covered space through the center which serves both as corridor and as covered play area for rainy or excessively hot weather. The skylight also runs across the classroom ceilings and yields direct overhead light to the inner sides of the rooms.

Credits: Annex to White Oaks Elementary School; San Carlos Elementary School District, San Carlos, California, Miss Ruth W. Melendy, Superintendent. Architect: John Carl Warnecke, A. I. A., San Francisco and Oakland.

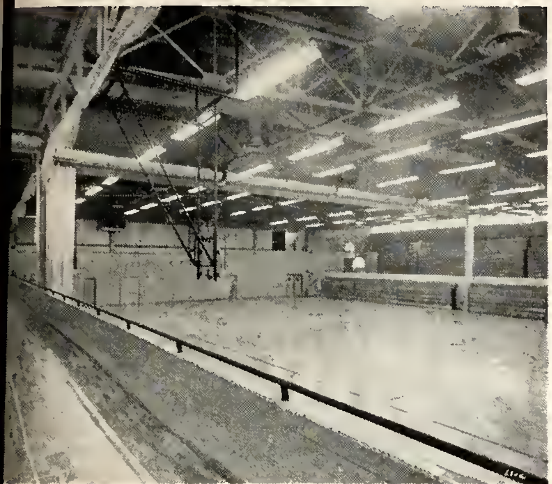
CASE STUDY 84

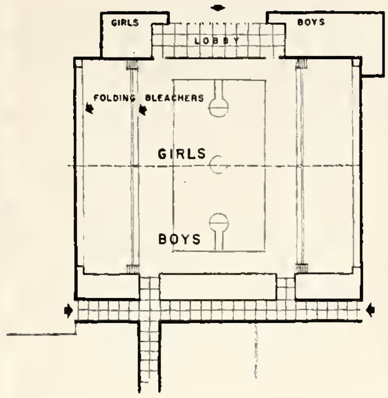
PROBLEM: Can stages have maximum flexibility to conform to the high school program?

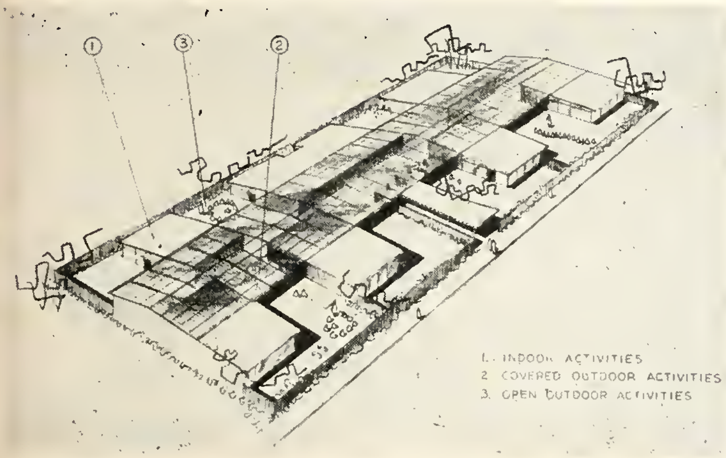
APPROACH: If the process of education is not to be merely imitative, the function of a stage in a high school is to supply more than a replica of an adult theater. Yet most high school stages are just that—copies. They lack the flexibility for an up-to-date high school program. Consider what happens. There is usually a Christmas and a senior "play" period. Out of approximately 36 weeks in a school year, this takes approximately four. For the other 32 weeks and for the other uses of the auditorium, there is usually an empty theater with a proscenium obviously too small, curtains and rigging that deteriorate fast, a "peephole" relationship between audience and stage, and a generally makeshift environment for other purpose. The smug provision of a stage with curtains and perhaps some lighting actually provides a "block" against satisfying needs of the program. The wide range of activities from musicals to speeches, involving as many as 300 participants to one speaker, creates a problem that can only be solved by a fresh approach. Such an approach was taken by the designer of this school.

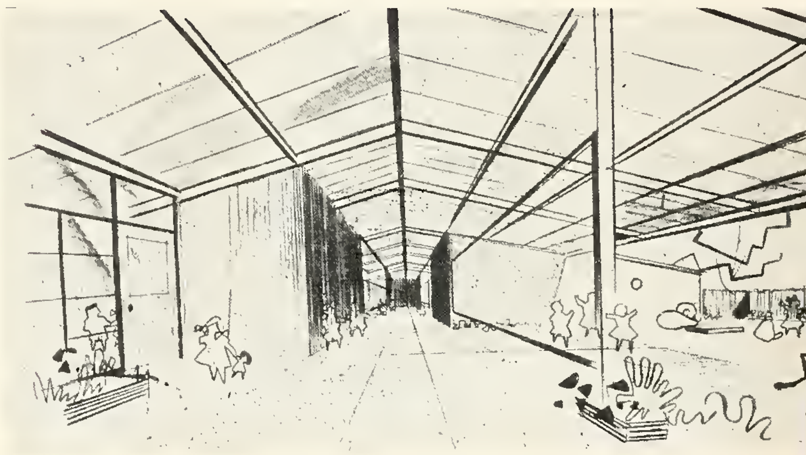
SOLUTION: The solution has these possibilities: (1) a large, free and open space for better dissemination of thought, announcements, and ideas, with little or no barrier between the disseminator and the disseminatee; (2) a large stage area for band, choral work, graduation, public meeting, accomplished by utilizing the normal "side stage space," with the same lack of barrier as in (1); (3) the lack of affectation so marvelously accomplished in the Scandinavian work; this extends to an avoidance of fake pomp usually associated with the theater, and (4) for the theater arts, a stage susceptible of imaginative handling, for experiment with "theater in the round" techniques (at least in front), for experiment without scenery, and for experiment with inventive new techniques using two sides of the stage, alternately curtained, for large stages in pageants. In other words, the stage has been designed as a flexible unit.

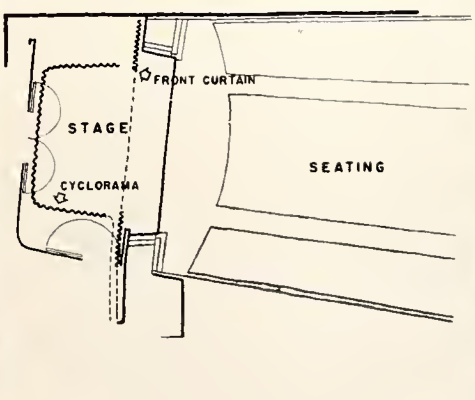
Credits: This design was developed by Donald Barthelme and Associates for the Sweeny High School, Sweeny, Texas. The Superintendent of School was A. T. Bledsoe.

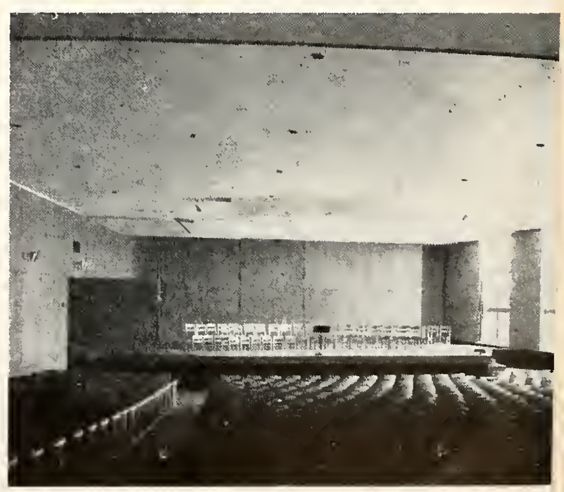



GIRLS
LOBBY
BOYS
FOLDING BLEACHERS
GIRLS
BOYS


1
3
2
1. INDOOR ACTIVITIES
2. COVERED OUTDOOR ACTIVITIES
3. OPEN OUTDOOR ACTIVITIES




FRONT CURTAIN
STAGE
SEATING
CYCLORAMA



CASE STUDY 85

PROBLEM: What is one way to darken a classroom for the projection of pictures with the least amount of effort and time?

APPROACH: The architect was aware that most devices for the darkening of windows are cumbersome to operate and often interfere with the ventilating function of the windows. If the effort and the time consumed to darken the room are too great, the teacher is discouraged from using this teaching aid. Improvements in projection screens no longer require totally dark rooms, and some screens permit a relatively high level of light in the room. If windows are the major source of trouble from the darkening standpoint, why not reduce the amount of windows? The reduction of window area, however, is an advantage only if ways are found to maintain good seeing conditions and if any other light sources permit easy darkening with no ventilation complications.

SOLUTION: If windows areas are to be reduced, the head of the window must come down, since it was desired to maintain a low sill height for vision. If window heads are lowered, the daylight contributed by window sources is not sufficient to provide desired seeing conditions and other sources of light must be provided. The architect decided to use a continuous skylight, parallel to the outside walls and so located as to furnish a light intensity as even as possible over the full width of the room. Windows are still retained on both outside walls for both light and ventilation. Metal louvers were incorporated into the skylight design that could be adjusted from the wall by a single crank (other than the teacher!). These louvers, being located on the skylight, do not interfere either with vision or ventilation as they would if located on the windows. In order to provide a skylight free of structural framing members, the architect framed the building with spanning members parallel to the outside wall. After the decision was made to lower the window heads, it was decided to lower the ceiling to correspond with the height of the window head. The resulting room has a very low ceiling, which makes a very pleasantly proportioned room.

Credits: This is the Brittan Acres School, San Carlos, California, designed by John Lyon Reid, Architect. The Superintendent was Miss Ruth W. Melendy. Photography by George B. Haberkorn.

CASE STUDY 86

PROBLEM: What type of light fixture can be used with ceilings of low light reflection such as natural wood?

APPROACH: Functional artificial lighting in harmony with the architecture was the prime consideration in the selection of a fixture for this school. It was desired to create a homey, non-institutional atmosphere for small children, kindergarten through third grade. Extensive use of natural wood and brick, for ceiling and wall treatment, was employed in carrying out this design concept. The usual classroom lighting fixtures designed for use with highly reflective light-colored ceilings, do not function efficiently when used with wood ceilings as in this school. Fluorescent fixtures were ruled out as being inharmonious with the design of the room. The interest of economy precluded consideration of custom-built fixtures. Next, fixtures were selected that seemed close to the solution and samples were obtained and hung under conditions similar to the proposed application. The essential elements of these fixtures consisted of a silver bowl lamp shielded with concentric ring louvers covered with dome-type reflector. The reflector of the first fixture was metal, 36 in. in diameter with mat white reflecting surface. This fixture met most of the requirements except no light was transmitted to the ceiling and the resultant dark ceiling was objectionable. The second reflector was of fiberglass, 24 in. in diameter. Although some light was transmitted to the ceiling, the brightness of the reflector was too great. From these observations, it was determined that a reflector of approximately 20 per cent light transmission, and somewhere between the two diameters tested, would be satisfactory.

SOLUTION: A local representative of a lighting company, who had a sympathetic understanding and a desire to help, took the problem to the factory and a reflector was produced, made of white translucent plastic 31 in. in diameter with frosted reflecting surface and polished outside surface. Under test conditions, this fixture provided adequate uniform light at the work level, and a well-lighted ceiling without excessive glare and within reasonable standards of brightness ratio. The final product justified the approach in seeking the solution through technical modification rather than design compromise.

Credits: These fixtures were installed in the David P. Lapham Elementary School, Dearborn, Michigan, and were designed by Jahr-Anderson Associates, Inc., Architects. James A. Lewis was the Superintendent.

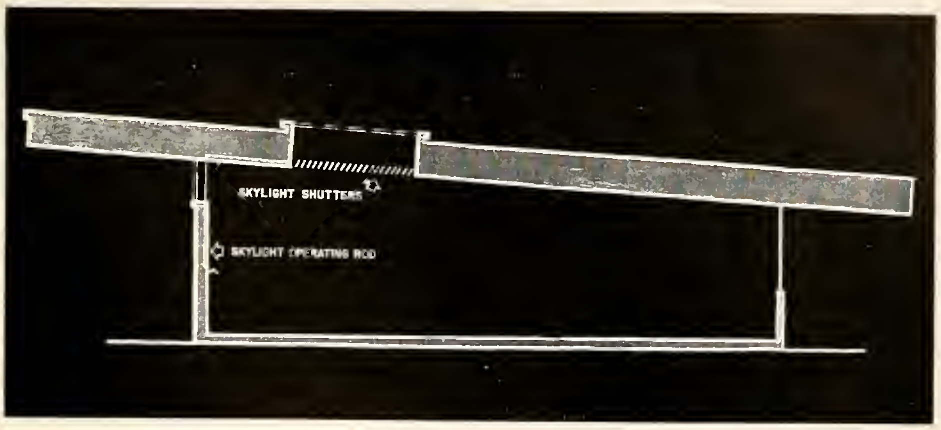
CASE STUDY 87

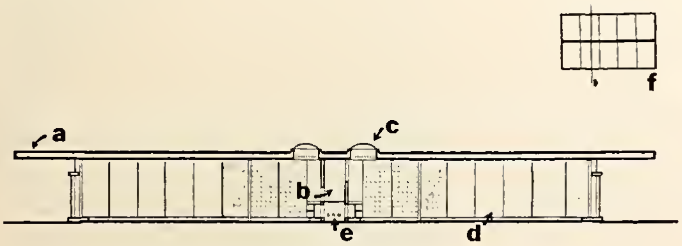
PROBLEM: Are the requirements of flexibility and economy compatible?

APPROACH: The planners of this school were confronted with a fast changing educational program and a low construction budget. Flexibility was a must, and it could not be obtained at a premium. In fact, during the programming stage the planners decided that the space requirements could only be determined for two years. After that the building would have to take care of internal changes efficiently and economically by its own character of flexibility. In order to solve this problem, the planners decided upon an umbrella type structure, held up on columns which free the interior walls of structural support. For interior walls, the planners decided upon the use of "space dividers" described in Chapter 6. These units have two functions: (1) to allow for innumerable interior changes, and (2) to make every square foot of interior wall space a teaching device. Because of economy, the planners arrived at a back-to-back arrangement of classroom wings connected together by a spline which the architects call a "utility core." Actually the core is a device for facilitating cross ventilation for each classroom wing and houses all of the utilities such as heating supplies, plumbing, and electrical services. It also contains the built-in so that the classroom wings will be free of any stationary partitions which would limit the flexibility. These schemes were developed with the very close cooperation of the superintendent. A physicist was brought into the planning picture to help develop the sound-reducing ventilating core.

SOLUTION: The solution is based on three major architectural features. Notice the sketch. The first is the top-lighted lift-slab roof (A). Refer to photograph 58 in text. The second is the teaching space dividers (B), whose total cost was only one-twenty-fourth of the total cost of construction; yet these devices of teaching put every square foot to use. And the third is the utility core, (C), which facilitates the natural air flow in the interior spaces and which contains all of the utilities, easily accessible for maintenance, plus all built-ins and classroom sinks. The cross-section above shows the outside peripheral corridor at (a), the plastic dome sky-lights (c), the sound reducing duct of the core (b), the utility duct (e), and the teaching space dividers (d). Diagram (f) shows the back-to-back arrangement of classrooms which in this case are 36 ft. deep and 24 ft. across; however, because of the movable quality of the space dividers, the classrooms can be made much wider. And any good custodian can do it!

Credits: This scheme was developed by Caudill, Rowlett, Scott and Associates, Architects, for the schools in Laredo, Texas. A. A. Leyendecker was the Associated Architect. Dr. Elmer Smith helped in the development of the core idea. William Nixon was the Superintendent of Schools.


SKYLIGHT SHUTTERS
SKYLIGHT OPERATING ROD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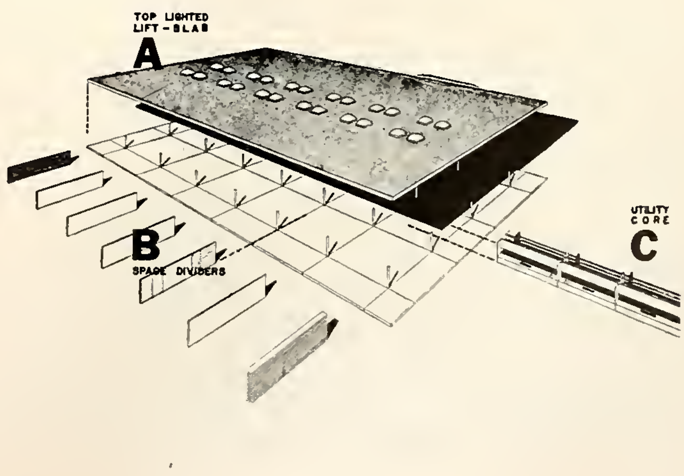

TOP LIGHTED
LIFT-SLAB
A
B
SPACE DIVIDERS
UTILITY
CORE
C

CASE STUDY 88

PROBLEM: Can schools and parks be combined successfully to satisfy economical and operational requirements?

APPROACH: In this particular situation the school and park were located on adjacent property.

Both the School Board and Park Board had building programs for new facilities to be located on adjacent properties. Through a development period including meetings among members of both school and park departments and the residents of the district, it was decided to combine efforts and facilities for joint use to obtain better service and economy of construction. Studies indicated that this joint arrangement would eliminate duplication of construction and minimize future operation and maintenance costs. Since each required gymnasium, stage, craft rooms, shops, etc.—why not a single, better unit that could be used by everyone? An educational program was launched by the School, Park, City Planning Commission and Architect to illustrate desirabilities of this approach to the community. The community accepted this joint use scheme and final architectural plans were prepared in close harmony with school and park committees.

SOLUTION: Through these combined efforts, the gymnasium has much more space than a Junior High or a Park Class A field house and seats approximately 1200. A large combined playfield includes 21 acres. The Park Department unit was composed of offices, social rooms, lounges, game rooms and kitchen and was integrated with the school building and yet given complete segregation by provision of its own entrances. (see 2 on diagram) its own keying system and its use of joint automobile approach and parking areas. The gymnasium, auditorium, music rooms, and shops have been segregated with easy egress for both park and school and to allow proper scheduling and control. Of course; after school hours full use is given to these facilities by the community. The classroom wing is a one story simple frame structure with abundant means of egress with the main entrance by an open court (see 1 on diagram).

Credits: This is the Catherine Blaine Junior High School and Recreational Project designed by J. Lister Holmes and Associates, Architects, Seattle, Washington. The Superintendent was Samuel E. Fleming.

CASE STUDY 89

PROBLEM: Can the pupil have a part in planning and building the school?

APPROACH: Much is said these days about pupils participating in planning and building schools, but very little is done about it. Here is an exception. The fifth and sixth grade children were the ones involved. In the words of Miss Ferne Thorne, this is what happened: "The pupils and teachers met with the superintendent, Mr. McCombs, to hear about such problems as acquiring additional land, financing the project, and arranging for the care of classes. They listened intently as members of the Buildings and Grounds Department told of the new play areas planned. The unsightly dump on the east border of the grounds was to be drained, filled, and made into a playground. They asked the architect, Mr. Bill Wagner, to show them the drawings and to explain the blueprints. Mr. Wagner threw them a big challenge. Would they like to have a part in making the building? Would they like to plan six animal plaques to be placed about the entrance of the kindergarten unit? Would they? They would indeed! The pupils of grades five through six discussed the possibilities. A committee met with the kindergarten pupils and teachers for suggestions of animals that appealed especially to the five-year olds. The committee reported its findings to the practical art classes. Twelve sketches from a large group made by the classes were selected by the pupils. Next came the problem of translating the pencil sketches into plasticine bas-reliefs in the exact dimensions of the openings about the entrance. The children then asked a faculty committee to select the best six plaques."

SOLUTION: Some of the plaques are seen here. The six finalists with their advisers visited the stonecutters who were to copy the plasticine bas-reliefs on stone. There they watched their animals slowly take shape on stone blocks under the skillful hands of the artisans. The reproductions were amazingly accurate, including even the slightest deviations which were a product of the childish imagination of the creators. It was a big day for the entire school when the stone plaques were set in their place. To the children the new building must have been truly theirs.

Credits: This project was in connection with planning the addition to the Park Avenue School, Des Moines, Iowa. Credit is extended to N. D. McCombs, Superintendent, and to his fine staff of art instructors. Ferne Thorne was the Principal. The Architects were Wetherell and Harrison.

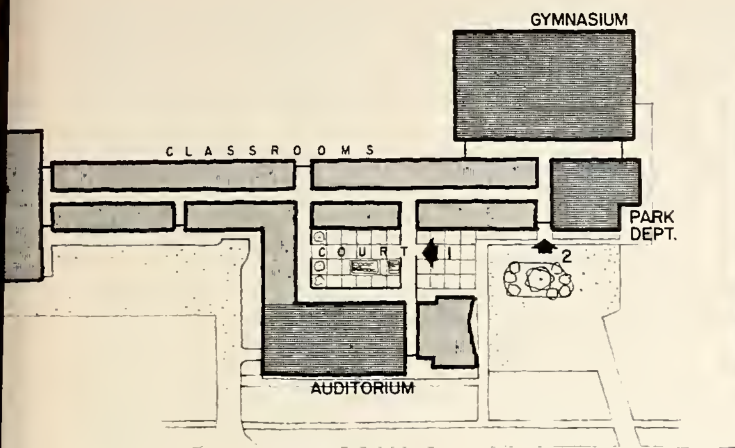
CASE STUDY 90

PROBLEM: What are the requirements of the building fabric?

APPROACH: The fabric which covers a building, having non-load bearing walls, has only two real requirements: (1) to protect the occupants from the elements, and (2) to require as little renewing as possible. The architect made his approach on these premises. He was not satisfied that schools should be built as forts were built. For one thing, the conventional construction methods were too expensive. So he set out to devise a system of covering the structural frame with a "single skin which could be employed to serve also the purpose of interior finish." He knew economy could be accomplished. The sketches shown are graphic indications of his thinking. He starts with the structural frame (top sketch) which has repetitive frames for economy. Next he considers the fabric of the outside walls and how this fabric will fit onto the frame. (Left sketches). Then he considers the roof fabric and its connects with the structural frame (right sketch). And then the fabrics of the inside walls are given consideration. After much study, he makes the final selections.

SOLUTION: For the outside (street side) fabrics, the architect selected ⅞ inch marble slabs. The selection was based on the fact that marble is permanent, requires no upkeep, and has high reflectivity to bounce back the west sun—also it is beautiful. It has its own built-in color for both exterior and interior finish. Here is a case where a material having an expensive reputation is given a low cost price tag. For the roof fabric, the architect selected a material which has the following qualities: (a) can be used as a structural roof deck, (b) is economical, (c) has thermal insulation value, (d) has acoustical insulation value and appearance for an excellent ceiling material, (e) and has its own factory color. And for the inside (court side) fabrics he selected panels of fixed glass and sliding windows, together with movable cork tackboards. The right photograph shows the installation of the marble wall panels and the left photograph shows the inside court glass and corkboard panels.

Credits: This is the West Columbia Elementary School. West Columbia, Texas, designed by Donald Barthelme and Associates, Architects. The Superintendent of Schools was J. C. Rogers, Jr.


GYMNASIUM
CLASSROOMS
COURT
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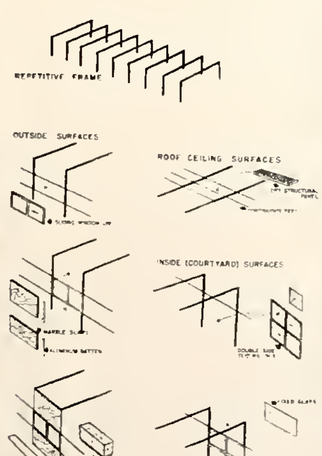
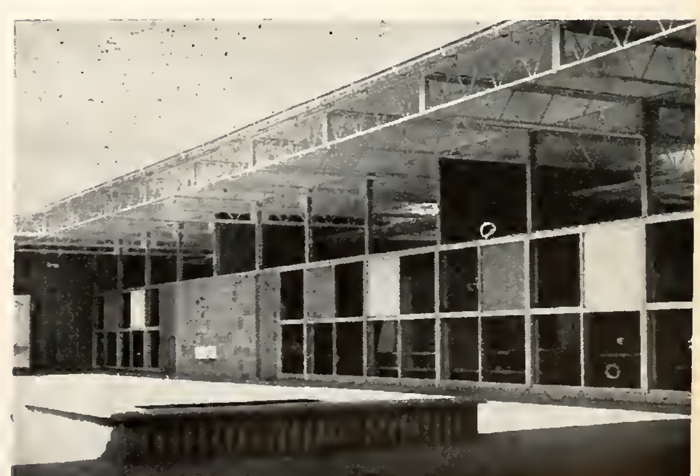
PARK DEPT.
AUDITORIUM


REPETITIVE FRAME
OUTSIDE SURFACES
ROOF CEILING SURFACES
INSIDE (COURTYARD) SURFACES



CASE STUDY 91

PROBLEM: How can teaching devices be grouped for effective use?

APPROACH: The study of this problem resulted in the development of the so-called Teaching Center. In the very early stages the planners of this school made a thorough study of the activities which go on in an up-to-date elementary classroom. Among other things, they found (1) that effective teaching can result through class dramatizations, (2) that the children have occasions for making large murals on common wrapping paper, (3) that the teacher and also the pupils need space for demonstration of new skills and concepts, (4) that pupils work in groups, some may be drilling, others may be doing art work, and (5) that there is a great need for ample tackboard space. This study also brought out the need for storage space for materials and supplies.

SOLUTION: The Teaching Center, a product of this study, is shown here. It is a free standing unit. The right photograph shows the front view and the left photograph the back view. Its function can be related to the numbers above: (1) It facilitates dramatization by affording a backdrop with its twelve feet of tackboard on which scenery may be secured and by providing space behind the unit for waiting performers. (2) On the back and front, divided evenly, there are twenty-four feet of tackboard on which large wrapping paper murals can be made and exhibited. (3) On the front there is six feet of demonstration chalkboard. (4) By being a free standing unit, there is space behind for committee meetings or space for individual art work with easels provided. (5) The twenty-four feet of tackboard provide ample space for tacking the pupils' work and visual material. The Teaching Center serves other purposes. It serves to screen the wardrobe pegs and shelves. It also provides storage for teaching supplies and the teacher's wardrobe storage and files; this unit is behind the demonstration chalkboard.

Credits: This scheme, developed in 1948, is the prototype for many since then. It was designed in connection with the Blackwell Elementary Schools, Blackwell, Oklahoma. Caudill, Rowlett, Scott and Associates affiliated with Philip A. Wilber, Architect, and Ray E. Means, Engineer, were the designers. J. Arthur Herron was the Superintendent of Schools. Photography by Julius Shulman.

PHOTOGRAPH CREDITS

NO.

1 Compliments of San Antonio Express-San Antonio Evening News.

9a The old Washington School, Blackwell, Oklahoma
Photograph by Larry Fisher

9b Blackwell Elementary School, Blackwell, Oklahoma
Caudill, Rowlett and Scott, Architects
Photograph by Julius Shulman

10 New York Free School, New York City
Photograph by Brown Brothers

11 Design of a schoolhouse by Dockstader and Considine, Architects

12 The Berkeley School, New York, N.Y.
Lamb and Rich, Architects

13 Twelfth Ward Grammar School, New York, N.Y.
C. B. J. Snyder, Architect

14 Public School 42
Photograph by Brown Brothers

15 School in Virginia built about 1890
Photograph by Brown Brothers

16 Public School 95, New York, Built about 1915
Photograph by Brown Brothers

17 Paterson Public School, built about 1915
Photograph by Brown Brothers

18 Spring Branch School, Houston, Texas
Wyatt C. Hedrich, Architect
Compliments of American Structural Products Company

19 Mira Vista Elementary School, Richmond, California
John Carl Warnecke, Architect
Photograph by Rondal Partridge

20 School by Architects Collaborative Photograph by Ezra Stoller

23 Photograph by Brown Brothers

24 Photograph of a school by John L. Reid, Architect

25-34 Photographs by Roland Chatham Studio

37 Clara Bryant Junior High School, Dearborn, Michigan
Eberle M. Smith, Architect
Photograph by Elmer L. Astleford

38 Portola Junior High School, El Cerrito, California
John Carl Warnecke, Architect
Photograph by Rondal Partridge

40 Photograph by Roland Chatham Studio

41 Evanston Township High School, Evanston, Illinois
Perkins and Will, Architects
Photograph by Hedrich-Blessing

42 Blythe Park School, Riverside, Illinois
Perkins and Will, Architects
Photograph by Fran Byrne

43 Greenwood Elementary School, Woodstock, Illinois
Perkins and Will, Architects

44 School by John L. Reid, Architect
Photograph by Roger Sturtevant

45 Westwood Elementary School, Woodstock, Illinois
Perkins and Will, Architects

46 Lakeside School near Bakersfield, California
Frank Wynkoop and Associates, Architects
Photograph by Raymond T. Geers

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47 Evanston Township High School, Evanston, Illinois
Perkins and Will, Architects
Photograph by Hedrich Blessing

48 Greenwood Elementary School, Woodstock, Illinois
Perkins and Will, Architects

49 Portola Junior High School, El Cerrito, California
John Carl Warnecke, Architect
Photograph by Julius Shulman,

56 See 9 b.

57 Alice M. Birney School, Rivera, California
Daniel Mann, Johnson and Mendenhall, Architects
Photograph by William H. Olson

58 East Rivers School, Atlanta, Georgia
Stevens and Wilkinson, Architects
Photograph by Hedrich-Blessing

59 Tamalpais Union High School, Mill Valley, California
Kump and Falk, Architects
Photograph by Phil Palmer

60 School at Elk City, Oklahoma
Caudill, Rowlett and Scott, Architects
Photograph by Ulric Meisel

61 Albany Schools, Albany, Texas
Caudill, Rowlett and Scott, Architects
Photograph by Ulric Meisel

62 McDonogh School No. 39, New Orleans, Louisiana
Goldstein, Parham and Labouisse, Freret and Wolf, and Curtis and Davis, Architects
Photograph by Hill Pedego

63 West Columbia Elementary School, Brazoria County, Texas
Donald Barthelme and Associates, Architect
Photograph by Meisel Photo and Color Service

64 Fairview School, Elk City, Oklahoma
Caudill, Rowlett and Scott, Architects

65 Photograph by Hedrich Blessing

69 New Corn Exchange, Nottingham, 1850
T. C. Hine, Architect
Photo from Oct. 19, 1850 "Illustrated London News."

70 West Columbia Elementary School, Brazoria County, Texas
Donald Barthelme and Associates, Architect
Photograph by Meisel Photo and Color Service, Inc.

71 Albany Schools, Albany, Texas
Caudill, Rowlett and Scott, Architects
Photograph by Ulric Meisel

72 School at Industry, Texas
Caudill, Rowlett and Scott, Architects
Ulric Meisel, Photographer

73 Mira Vista Elementary School, Richmond, California
John Carl Warnecke, Architect
Photograph by Rondal Partridge

79 Del Mar Elementary School, Fresno, California
Franklin and Simpson, Architects

80 Elementary School, Welcome, Texas
Caudill, Rowlett and Scott, Architects
Photograph by Roland Chatham Studio

81 Baker School, Mountain View School Dist. California
Kistner, Curtis and Wright, Architects

NO.

82 School at Carmel, California
Ernest Kump, Architect
Photograph by Roger Sturtevant

83 Will Rogers Elementary School, Stillwater, Oklahoma
Phillip A. Wilber and Caudill, Rowlett and Scott, Architects
Photograph by Suter, Hedrich-Blessing

84 Science Building, Texas A. and M. College, College Station, Texas
Carlton Adams, Architect

85 Fairfax School, Fairfax, California
Bamberger and Reid, Architects
Photograph by Roger Sturtevant

86 A. and M. Consolidated School, College Station, Texas
Langford and Finney, Architects

87 Blythe Park School, Riverside, Illinois
Perkins and Will, Architects
Photograph by Hedrich-Blessing Studio

90 Barrington Countryside School, Barrington, Illinois
Perkins and Will, Architects
Photograph by Hedrich-Blessing

98 Washburn School Addition, Auburn, Maine
Alonzo J. Harriman, Inc., Architects
Photograph by Joseph W. Molitor

99 Grandview School, Catskill, New York
Henry Blatner Architect
Photograph by Robert Damora

100 Highland Park School, Stillwater, Oklahoma
Caudill, Rowlett and Scott, Architects
Photograph by Suter, Hedrich-Blessing

101 Southgate Elementary School near Seattle, Washington
Ralph Burchard, Architect
Photograph by Dearborn-Massar

102 West Columbia School, West Columbia, Texas
Donald Barthelme & Associates, Architect

103 School near San Antonio, Texas
B. K. Wyatt, Architect
Photograph by Harvey Patteson & Son, courtesy Stran-Steel Co.

104 School Building by Kump and Falk, Architects
Photograph by Skelton Studios

105 Laredo, Texas
Caudill, Rowlett, Scott and Associates, Architects

106 Wilson School, Miami, Texas
Caudill, Rowlett, Scott and Associates, Architects
Photograph by Orrick Sparlin

107 Bonner Elementary School, Houston, Texas
Herbert Voelcker and Associates, Architects
Photograph by Bob Bailey

110 Addition to Grandview School, Catskill, New York
Henry L. Blatner, Architect
Photograph by Ben Schnall

111 Darien Junior High School, Darien, Connecticut
Ketchum, Gina & Sharp, Architects

115 Southgate Elementary School near Seattle, Washington
Ralph Burchard, Architect
Photograph by Dearborn-Massar

116 Mira Vista Elementary School, Richmond, California
John Carl Warnecke, Architect
Photographed by Rondal Partridge

117 Greenwood Elementary School, Woodstock, Illinois
Perkins and Will, Architects

NO.

130 Kester Avenue School, San Fernando Valley, California
Richard J. Neutra, Architect
Photograph by Julius Shulman

131 Buri-Buri School, South San Francisco, California
Bamberger and Reid, Architects
Photograph by George B. Haberkorn

132 Mesita School, El Paso, Texas
Carroll and Daeuble, Architects
Photograph by Julius Shulman

133 Montecito School, Martinez, California
John L. Reid, Architect
Photograph by Roger Sturtevant

134 West Columbia Elementary School, Brazoria County, Texas
Donald Barthelme and Associates, Architects
Photograph by Meisel Photo & Color Service, Inc.

136 Kester Avenue School, San Fernando Valley, California
Richard J. Neutra, Architect
Photograph by Julius Shulman

137 Blythe Park, Riverside, Illinois
Perkins and Will, Architects
Photograph by Bill Hedrich, Hedrich-Blessing

138 Blythe Park School, Riverside, Illinois
Perkins and Will, Architects
Photograph by Hedrich-Blessing Studio

142 Washington School, Clinton, Oklahoma
Caudill, Rowlett and Scott, Architects
Photograph by Ulric Meisel

143 Blackwell Elementary School, Blackwell, Oklahoma
Caudill, Rowlett and Scott, Architects
Photograph by Julius Shulman

144 Westwood Elementary School, Stillwater, Oklahoma
Caudill, Rowlett and Scott, Architects
Photograph by Suter, Hedrich-Blessing

145 Will Rogers Elementary School, Stillwater, Oklahoma
Phillip A. Wilbur, Caudill, Rowlett, Scott and Associates, Architects
Photograph by Hedrich-Blessing

146 Industry, Texas
Caudill, Rowlett, Scott and Associates, Architects
Photograph by Ulric Meisel

147 Alhambra Union High School, Martinez, California
John Lyon Reid, Architect
Photograph by Roger Sturtevant

148 Herbert Hoover High School, San Diego, California
Courtesy of the H. H. Robertson Company

149 Our Lady of the Lake School, Seattle, Washington
Paul Thiry, Architect
Courtesy of American Structural Products Company

150 Combined school building at Wiscasset, Maine
Alonzo J. Harriman, Inc., Architects
Photograph by Joseph W. Molitor

151 Blythe Park School, Riverside, Illinois
Perkins and Will, Architects
Photograph by Hedrich-Blessing

152 Corona Avenue School, Los Angeles, California
Richard J. Neutra, Architect
Photograph by Julius Shulman

153 Acelanes Union High School, Lafayette, California
Kump and Falk, Architects
Photograph by Roger Sturtevant

154 Crow Island School, Winnetka, Illinois
Perkins, Wheeler and Will, Architects
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NO.

155 Courtesy of the Architectural Forum—October 1949.

161 Northeast Intermediate School, Midland, Michigan
Alden B. Dow, Architect
Photograph by Bill Hedrich, Hedrich-Blessing

162 School by Architects Collaborative
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163 School by Architects Collaborative
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164 Evanston Township High School, Evanston, Illinois
Perkins and Will, Architects
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165 Washington School, Clinton, Oklahoma
Caudill, Rowlett, Scott and Associates, Architects
Photograph by Ulric Meisel

166 Blackwell Elementary School, Blackwell, Oklahoma
Caudill, Rowlett, Scott and Associates, Architects
Photograph by Julius Shulman

167 John Muir School, Martinez, California
John L. Reid, Architect
Photograph by Roger Sturtevant

168 West Columbia Elementary School, Brazoria County, Texas
Donald Barthelme and Associates Architect
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169 School by Kump and Falk, Architects
Photograph by Phil Palmer

170 Albany Schools, Albany, Texas
Caudill, Rowlett, Scott and Associates, Architects
Photograph by Ulric Meisel

172-174 Blythe Park School, Riverside, Illinois
Perkins and Will, Architects

177 Blythe Park Elementary School, Riverside, Illinois
Perkins and Will, Architects
Photograph by Hedrich-Blessing Studio

178 Northeast Intermediate School, Midland, Michigan
Alden B. Dow, Architect
Photograph by Bill Hedrich, Hedrich-Blessing

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Perkins and Will, Architects
Photograph by Hedrich-Blessing Studio

180 Evanston Township High School, Evanston, Illinois
Perkins and Will, Architects
Photograph by Hedrich-Blessing

187 Bellflower High School, Bellflower, California
Kistner, Curtis and Wright, Architects

188 Blythe Park School, Riverside, Illinois
Perkins and Will, Architects
Photograph by Hedrich-Blessing Studio

189 Westwood School, District #10, Woodstock, Illinois
Perkins and Will, Architects
Photograph by Hedrich-Blessing Studio

190 Blackwell Elementary School, Blackwell, Oklahoma
Caudill, Rowlett, Scott and Associates, Architects
Photograph by Julius Shulman

NO.

191 Webster School, Pella, Iowa
Smith and Vorhees and Jensen, Architects

192 Unit developed by Ernest J. Kump, Architect

193 Buri-Buri Elementary School, South San Francisco, California
John L. Reid, Architect
Photograph by Roger Sturtevant

194 Sherwood-Bates Elementary School, Raleigh, North Carolina
William Henley Deitrick, Inc. Architect
Photograph by Joseph W. Molitor

195 Albany Schools, Albany, Texas
Caudill, Rowlett, Scott and Associates, Architects
Photograph by Ulric Meisel

196 Will Rogers Elementary School, Stillwater, Oklahoma
Caudill, Rowlett, Scott and Associates, Architects
Photograph by Suter, Hedrich-Blessing

197 Washington School, Stillwater, Oklahoma
Caudill, Rowlett, Scott and Associates, Architects
Photograph by Ulric Meisel

198 Unit designed by Ernest J. Kump, Architect
Courtesy American Seating Company

202 School by Architects Collaborative
Photograph by Ezra Soller

203 Will Rogers Elementary School, Stillwater, Oklahoma
Caudill, Rowlett, Scott and Associates, Architects
Photograph by Suter, Hedrich-Blessing

204 Northeast Intermediate School, Midland, Michigan
Alden B. Dow, Architect
Photograph by Bill Hedrich, Hedrich-Blessing

205 Washington School, Clinton, Oklahoma
Caudill, Rowlett, Scott and Associates, Architects
Photograph by Ulric Meisel

206 Fairview Elementary School, Elk City, Oklahoma
Caudill, Rowlett, Scott and Associates, Architects
Photograph by Ulric Meisel

207 Mira Vista Elementary School, Richmond, California
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208 Kester Avenue School, San Fernando Valley, California
Richard J. Neutra, Architect
Photograph by Julius Shulman

209 Albany Schools, Albany, Texas
Caudill, Rowlett, Scott and Associates, Architects
Photograph by Ulric Meisel

210 Our Lady of the Lake School, Seattle, Washington
Paul Thiry, Architect
Courtesy of American Structural Products Company

211 School by Perkins & Will, Architects
Photograph by Bill Hedrich, Hedrich-Blessing

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